amateur radio

JOURNAL OF THE WIRELESS INSTITUTE OF AUSTRALIA

FEBRUARY, 1973

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amateur radio

JOURNAL OF THE WIRELESS INSTITUTE OF AUSTRALIA. FOUNDED 1910

FEBRUARY, 1973
Vol. 41, No. 2

Published monthly, as the official journal, by the Wireless Institute of Australia. Reg. Office: Above 474 Toorak Rd., Toorak, Vic., 3142.

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Copy is required by the **third of each month**. Acknowledgment may not be made unless specially requested. All important items should be sent by certified mail.

The Editor reserves the right to edit all material, including Letters to the Editor and Hamads, and reserves the right to refuse acceptance of any material, without specifying any reason.

Advertising:
Advertisement material should be sent direct to the Editor **by the 25th of the month preceding the month prior to publication.**

Hamads should be addressed to the Editor **by the third of each month.**

Printers:
"RICHMOND CHRONICLE"
Shakespeare Street, Richmond, Vic., 3121
Phone 42-2419.

CONTENTS

COVER

The presentation in November of a beautiful certificate by Mr. I. W. N. Clarke as Branch Organiser of J.O.T.A. to Mr. Paul Hayden, President of the VK4 Division, marks the esteem in which the Scouts hold Amateur Radio.

QSP

SCHIZOPHRENIC

Lovely word, isn't it? According to one of my dictionaries it means "a person of split personality". Where could such a person fit into amateur radio?

We all agree that amateur radio is the greatest hobby in the world. It supplies a training ground for the future electronic wizards, it encourages peace and understanding between the peoples of the world, it can be enjoyed by young and old. BUT, let's face it, it also breeds some mighty peculiar types in its ranks. There is the HF man who thinks the spectrum stops at 30 megs., the VHF man who thinks CW is a barbaric form of communication, the AM man who can't bear duck talk, the list is endless.

One of the most peculiar is the man who does some job for the Institute. It may be relaying the Sunday broadcast every week for years on end, or organising a programme of lectures, or working on the Divisional Council, or one of the jobs, large or small, which must be done to keep the Institute a viable, active body.

Of this most peculiar group the one to whom the title "schizophrenic" can readly be applied is the Divisional Councillor. Within his home division he is regarded as representing that ferocious body, the Federal Executive. At Federal Conventions he is regarded as being the private devil sent to raise Hell by a Diabolic Division. If he didn't have a split personality when he started, it's London to a brick that he will have one after a couple of years.

With the formation of the Federal company the Federal Councillor's job became somewhat more exacting than before. Previously he could cast his vote with the knowledge that there was always the chance to retract on his return to his Division if he found that his vote did not reflect the Divisional attitude. Now that loophole has been closed, and his vote at the Convention is binding on the Division. In this day of rapid progress no one can afford to wait two or three months to make up their minds, and for this reason the Constitution of the Company made the requirement that the voting at a Convention be binding.

Where does this leave the Federal Councillor? Now, more than ever, he must be a man whom the Divisional members feel they can trust, and he must know the feeling within his Division on a number of widely different matters. The first qualification is one which is not easy to express. It is not necessarily being a "good egg" who will bend over backwards to carry out every whim of the members, for, by his position, the Federal Councillor often has access to classified information which has a direct bearing on the topic, and which he must apply without revealing. I think that to earn the member's trust, the Councillor must at all times give a straight answer, be it yes or no, and stick to it. This may not always win a popularity poll, but at least the members will know where they stand.

The second qualification is easy meat. All the Councillor has to do is monitor every contact on every band every day, and listen to every member all day every day. Obviously impossible, so what can he do? Not as much as YOU, the average member, can do. Your Federal Councillor will welcome your thoughts on Institute matters. Don't wait until the next General Meeting to pass them on. The P.M.G. has a wonderful system called the telephone, and it also runs a mail delivery service. Of course, if you hear the Councillor on the air, you can contact him there and pass on your thoughts, but please remember that he too would like to be a radio amateur sometimes, so let him enjoy the hobby once in a while. Most Federal Councillors are available at work by phone, but not all bosses are radio amateurs, so use some discretion during working hours. Judging by Federal Conventions, most Federal Councillors are night owls so there should be ample time after tea to ring him and let him know how you or a group of members feel on a particular topic. If you are so inclined, scribble your comments or thoughts on a sheet of paper and post or give them to your Councillor.

After 10 Federal Conventions I feel that one of the loneliest places in the world is sitting at the Convention table facing the rest of the delegates. It can be and is made less lonely by the knowledge that your Division has faith in your ability to protect their interests and that the members have given you the ammunition to fight on their behalf.

So far we have looked at the Federal Councillor from the Divisional side. From the Executive side the Councillor is the Division. All requests and directives are passed through the Councillor, and in exactly the same fashion the Executive must trust the Councillor to represent them fairly to the members. To this end, the Executive must accept the responsibility of passing on information to the Councillor so that he can assess the matter and discuss it with his Divisional Council and the members. As with the members, Executive sometimes leaves the Councillor in the dark as to feelings and thoughts on topics. The result is the same — the Councillor is left holding the baby.

Of all Institute jobs that of Federal Councillor is probably the most rewarding and most depressing. From one side or the other the Federal Councillor is bound to be wrong sooner or later, but if he is wrong for one, he is right for the other. Schizophrenic, yes; happy, YES.

GEOFF TAYLOR,
VK5, Federal Councillor.

COST OF "AMATEUR RADIO"

How much of your subscription is swallowed up by the cost of A.R.? 40 cents per copy? No. This is the cover price for direct subscriptions and "one off" sales. Your subscription in 1973 contributes $2.64 towards A.R. Can you think of any other periodical of comparable standard being as cheap as this? Out of this yearly amount the costs of postages, wrappers and addressing absorb about 90 cents, leaving only a little over 14 cents per copy for printing and other costs. Is this a bargain?

OSCAR 6 VHF BEACON

Late news prior to going to press is that the 435.1 MHz beacon is inoperative after nearly three months of excellent performance.

J.O.T.A.

The World Co-ordinator in Geneva writes that the 15th Jamboree-on-the-air, as heard via HB9S, was better than ever before. The station HB9S, located 1600 metres a.s.l., closed early because of a first-of-the-season blizzard—they said the temperature was —10 deg. C. and when they took the dipole down (the storm had attended to the quad) it was 5 in. thick with ice! The 16th J.O.T.A. is 20th and 21st October, 1973, so get your new diary entered up for this event.

JUNE, 1972, A.R.

Can anybody donate an unwanted copy of June, 1972, A.R. to the Executive office? This request derives from the fact that this issue is out of print.

CANBERRA EASTER CONVENTION, 1973

The dates are April 20th to 23rd in Canberra and a capital programme has been planned by the Canberra Radio Society, P.O. Box 1173, Canberra, A.C.T., 2601. The only problem may be accommodation. Early reservations are essential.

QUEENSLAND STATE CONVENTION, 1973

The date of the VK4 State Convention is 6th/7th October, 1973, instead of the Queen's Birthday weekend in June. The venue — Ipswich Amateur Wrestling Club Hall — tights optional.

(Continued on Page 5.)

TUNING THE QUAD— THE EASY WAY

BY S. E. MOLEN, VK2SG*

● Following on from his earlier article on the practical construction of quad arrays, VK2SG gives detailed instructions on the tuning procedure necessary to achieve their high performance capabilities.

Having built quads and tuned them and been on the bands for numerous years using them, I am surprised when I hear people say that quads are hard to tune or that three bands cannot be fed with one co-ax. Both these statements are incorrect when the correct procedure of tuning is used. Of course, if one's approach is haphazard then anything is hard to do! Another idea that seems to have taken root is that the quad has a large vertical component. This statement has as much truth as the above about hard tuning, etc. But I will admit that if the quad is tuned incorrectly then all the previous statements are true.

What I am trying to say is that only if the quad is tuned correctly is it easy to tune, capable of one-line multi-band feed, practically free of vertical component, and free of reaction between the elements on different bands.

So what we need to know to get a quad working is how to tune it correctly. That, basically, is the purpose of this article.

To tune the quad we must firstly understand its operation. There are several good books available on quads and these are recommended for reading and study. After reading these books you should have some idea of what they are all about. It is not my intention to go into great detail on the operation of a quad but rather to concentrate more on their tuning. I will, though, make some broad comments on various aspects of the quad, and with your reading you will, I hope, be able to understand.

To understand the operation of a Quad or, for that matter, any aerial, we must understand the operation of a dipole for the dipole is the basis of all aerials. Here again I am not going to go to great detail on dipoles, but let us look at the current and voltage distribution. From Fig. 1 we can see that the centre of the dipole is at zero voltage, also the ends are at zero current, assuming, of course, that the aerial is resonant.

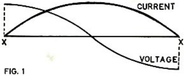


FIG. 1

Now this voltage and current distribution will remain constant whether we have the dipole horizontal, vertical or anywhere in between, provided that there is no outside influence in the field; also the distribution will remain relatively constant (with some slight distortion) even though the elements may be bent somewhere along their length. Again, if we place another resonant dipole in the field of the original dipole with quarter wave separation we will find a mirror image of the original voltage/current distribution appearing in this dipole. The closer it is placed to the original dipole the more current will be induced, and the phase angle will change. If we bend the ends of the elements towards each other we can arrive at a point where the ends of the elements are in phase with each other and there is no voltage or current difference. At this point the ends of the elements will be touching and distribution of current and voltage will be equal around the loop formed. What we now have is an extended folded dipole in the form of a square. This forms the driven element of a quad.

So we now have an active quad element which on its own will exhibit an impedance of approximately 72 ohms and will give a gain slightly less than stacked dipoles, due to the slight distortion of the current and voltage at the corners of the loop (Fig. 2). The gain of the loop will be about 0.9 dB. as against 1 dB. with stacked dipoles, but of course we would have to feed the two dipoles in the correct phase and correctly tuned; whereas with the loop we feed it at one point only and the rest takes care of itself.

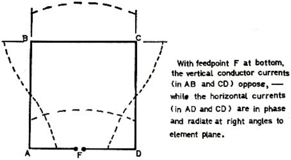


FIG. 2 —CURRENT DISTRIBUTION ON QUAD LOOP

We now have a loop and we can turn this into a cubical quad by adding a reflector and/or director/s. By doing this, we can increase the gain of the aerial. For the first parasitic element it is better to add a reflector than a director. By adding a reflector we can get 5.8 dB. gain, whereas by adding a director we can only get 3.4 dB. Also the back-to-front ratio with the reflector is 25 dB., whereas with the director it is only about 10 dB. But the elements must be tuned, which is, of course, why this has been written. How does one tune a quad to get the best results?

I am assuming here that you have used a standard set of measurements, that you have followed all the constructional methods of the previous article, and that you have the quad ready to tune. So we won't worry about the construction, only the tuning.

The first element to tune is the reflector. The reason for this is that if we tune the driven element first, any changes we make to the reflector and directors will be reflected in changes in tuning of the driven element. Therefore, we would have to re-tune the driven element again, the original tuning being a waste of time. There is a school of thought that says if you make the reflector 5% longer than the driven element it is correctly tuned. This is roughly true, but in practice it may be necessary to make the reflector 4½% longer or even 5½% longer, and we cannot say exactly how long the reflector need be until we start tuning. As you can see it will be hard to change the size of the reflector after we have it in the air, so while it is possible to use a full loop, there is no guarantee that it will be accurately tuned when you get it in the air. Therefore, I use stubs in the reflector and directors, permitting them to be accurately tuned.

LOW SIGNAL SOURCE

So we set about tuning the reflector with a few very simple tools. If you take a lead from the S meter of your receiver so that you can take the meter to the quad, you can tune the reflector on your own. The tools needed will be the extended S meter, a long shank screwdriver and a soldering iron, and

* 13 Pendle Way, Pendle Hill, N.S.W., 2145.

that is all. Of course you also need an external signal, which must not be too strong as this could be misleading, and it should be stable. It was found that a 12AT7 crystal oscillator with the second half as a doubler, tripler or quadrupler, 120 volts on the plate, and situated about 300 feet away from the reflector provided adequate signal for the job. Too much signal may give a false indication, for example two dips with a rise above normal between them. Thus keep the signal as low as possible, detuning the oscillator if necessary, remembering to keep it at least 30 dB. above the residual noise of the receiver. A signal of S7 would be adequate for the purpose.

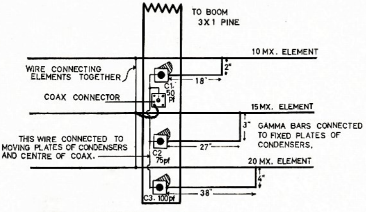


FIG. 4 3 BAND TRIGAMMA MATCH

TUNING THE REFLECTOR

Now to tune the reflector. Turn the back of the quad (reflector) on to the incoming signal, grasp the bottom of the stub in your hand and with the long shank screwdriver short out the stub at the top (away from your other hand). Now, watching your S meter, slide the screwdriver down the stub maintaining the short until the S meter dips (Fig. 3). Carefully checking this point for minimum signal, put a wire short across this point, check it again to make sure you have the exact point, and solder it.

Do the same for the other bands. It does not matter in which order you approach this tuning, whether you start at 28 MHz. or 14 MHz., the results will be the same. So that is the reflector tuned; it's as easy as that.

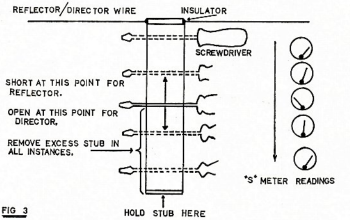


FIG 3

NOW THE DIRECTOR

If you are thinking of putting a director or directors on your quad, making it a 3, 4 or 5 element quad, it is no more difficult to tune the directors than it was to tune the reflector. Starting with the director nearest the driven element and turning the quad towards the incoming signal, we treat it in exactly the same way as we did the reflector, in other words we short out the stub for minimum signal, add on an inch away from the element and cut off the rest of the stub.

Now, with the stub open-circuited you will find a dramatic change in your S meter reading! If you have removed your screwdriver you will find the signal has increased. If you clip little bits at a time, about ⅛", you will find the signal gently increasing. When you clip the bits off keep them level and move away from the stubs and director to confirm your measurement. If you keep snipping untill the last snip causes the signal to fall slightly, you have gone too far; to correct this, take your soldering iron and put a blob of solder on the end of the stub. This not only holds the strands together but will bring the director back on tune.

Repeat this for each band and for each director, working out from the driven element. You will, of course, have to reduce the incoming signal from time to time as it is best to keep it at about S7 while tuning so that the a.v.c. in your receiver does not tend to flatten out and give you incorrect readings.

FEEDING THE QUAD

Now to tune the driven element; you thought I had forgotten it, didn't you? But before we get around to tuning the driven element let us consider the various methods of feeding. As you know, the simplest method is to feed it with co-ax. of the right impedance. This is effective for a single band quad with spacing such as to present the correct impedance, but if we intend to have more than one band, or if we change the spacing, we will find that the impedance has changed and therefore our co-ax. is mismatched. We could use a separate co-ax. for each band, but really don't you think this is a waste of good co-ax.?

A quad with a certain spacing exhibits a certain impedance. Adding further elements, changing spacing, c adding more wire (for other bands) changes the impedance, and so we have to change the co-ax. accordingly. Furthermore, if we use a quad of flat instead of spider configuration, we will have a different impedance on each band and therefore need a different type of co-ax. for each band. Whilst the spider configuration offers constant impedance on all bands, I am not too happy about the two top canes carrying all the weight! One could tie them back to each other, but this stiffens the whole structure and removes one of the best features of the quad—flexibility.

But to return to the feeding and tuning. With the flat configuration, we will have different impedances on each band. To overcome this, we can use one of the simplest and most effective methods of feeding, and that is the tri-gamma match. It has been said that this method of feed is hard to tune. This is not strictly true, for if the tuning is approached correctly it is fairly simple.

If we look at Fig. 4 we see the normal method of feeding the tri-gamma match, also the measurements of the gamma bars and the size of the condensers.

There are several ways of tuning the gamma match. One is to use a noise bridge, but you need a general coverage receiver at the start, to find out where you really are! I will admit that when one understands the operation of the noise bridge it is possible to get the quad on frequency and also read off the impedance. This does have some advantages and if you know anyone who has a noise bridge, see if you can get a loan of it; even ask him along to assist you with the tuning! Another method is to apply power to the aerial through an s.w.r. bridge. Incidentally, it is advisable to keep the power as low as possible, firstly to protect your final tubes, and secondly to reduce the QRM on the bands.

The use of the noise bridge does not require an s.w.r. bridge, whereas the use of power does require one. It will be up to you as to which method you use, but in both instances the tuning method is the same.

TUNING THE DRIVEN ELEMENT

Firstly, we check that all condensers are fully in mesh before we start our tuning; if they are not we could be led astray. The gamma bars should be slightly longer than necessary. Starting with 28 MHz. we tune the condenser for a dip in the s.w.r., which may not be great at this point. Do not take the condenser more than half out of mesh; if indications are that it needs to go further, adjust the gamma bar for a lower s.w.r. Do not, at this time, try for a very low s.w.r. on 28 MHz., but tune to 21 MHz. and repeat the process, and then tune to 14 MHz. Now, if you tune back to 28 MHz. you will find that the s.w.r. has changed. Tune the condenser and gamma bar for the lowest s.w.r., re-tune to 21 MHz. and do the same thing, and so to 14 MHz. And do it all again! Once more returning to 28 MHz., we are ready to tune for absolute s.w.r., and so to 21 MHz. and 14 MHz. As a final check on each band, you may need just a touch on the condenser to bring the beam "spot-on"; and that is the tuning finished.

One point to realise is that the gamma bars should be almost the same length as the stub in the reflector, providing the sides of the element are the same size, and the condensers should be about half in mesh. If the condensers are right out of mesh it indicates that the whole thing is tuned to a lower frequency, and one will need to re-tune, so that the condensers do finish in the half mesh condition. This can be done by adjusting the condensers on the three bands. It should not be necessary to touch the gamma bars, but if it is, they should need only very slight adjustment. While the s.w.r. will indicate low at all times, the quad will operate just that little bit better if this final check is carried out.

I realise that all this tuning is a little hard to do at the top of the tower, but it can be done at a lower level, say with the quad tied to the mast at a point where you can work on it from the ground. The tuning at this height will be slightly inaccurate, but it will not be far out, and when you get the beam to the top of the tower you will only have to make small adjustments to tune it "spot-on".

There is one other point to remember; when we tune the quad near the ground and then shift it up the tower the point of minimum s.w.r. will shift in frequency. If we want to have our quad tuned to say 14.2 MHz. when it is on top of the tower, we will have to tune it to 14.1 MHz. approximately when it is near the ground. A good rule of thumb for this is to allow 75 kHz. for the first 30 feet rise and 25 kHz. for every 20 feet above this. This is a useful basis to work to and makes the final tuning at the top so much simpler.

Finally, have you ever stopped to think what the quad looks like electrically? Actually, if we carefully look at the quad we will find that in reality we have stacked dipoles. In the case of the two element quad, electrically it looks like two stacked two element Yagis. The gain of the quad will be slightly less (owing to the corner distortion) than the stacked Yagis. Accordingly, a three element quad looks like stacked three element Yagis, and so on. So if you have ever wondered why a two element quad works so much better than the two element Yagi this is the reason. I think you will agree that quads are easy to tune; just think how long it has taken you to read this, allow for time to set up things and move around the aerial and that is how long it should take you to tune your own quad! ●

QSP (Continued from Page 2.)

RTS AND MISSING A.R's.

Means "returned to sender". Another reminder about A.R's returned to sender. As soon as an A.R. wrapper "returned to sender" is received through the post that mailing plate is removed from the plate file. If your A.R. does not reach you within two or three weeks of the time when everybody else receives theirs something has gone wrong. Write in to the Executive Office there and then so that something can be done about it; please do not leave it for months and months.

VK3 AMATEUR ADVISORY COMMITTEE

The Victorian Division nominations to the Advisory Committee for 1973 are VK's 3NT, 3ANG, 3ES, 3ZO and 3JS.

TWO-METRE BAND—9M2

The MARTS Newsletter of November gleefully reports that Malaysia (West) amateurs have had the 2-metre band restored to them. 144-146 MHz for amateur service and amateur Satellite service. 146-148 MHz for amateur service only, but this band has many frequencies occupied by other services. The newsletter suggests the use of 144.48 or 144.60 MHz for local use and goes on to report many FM stations operative in the K.L. area.

INTER-STATE TRANSFERS

If you move from one State to another (except for very short period visits) the Divisional Office of the State from which you depart should be advised so that your transfer can be processed through the central membership EDP records. If you were financial you will remain financial to the end of the calendar year so long as you would have continued being financial in the State from which you departed. If you were not financial at the time of your move you will be required to re-join the W.I.A. in your new State if you wish to continue membership. Because of inter-State advices when you notify your transfer and Divisional access to membership EDP records if required, you are not likely to be considered unfinancial in your new State if you were indeed financial in the State you left.

IMMIGRATION SPONSORSHIP

The Institute has been asked, nay been begged, to sponsor the immigration of a Chilean amateur with his wife and family. Sponsorship requires that accommodation be guaranteed for one year. We would like to help. Is there anybody able to assist? If so, please write to the Executive office for further details.

BERU, 1972

In the first 100 listed were VK2BPN, VK3MR, VK2GW, VK3ZC, VK3KS, VK6WO, VK2NS, VK3RJ and VK2OW. All VK call areas were represented.

Contest Calender

February. John Moyle Memorial National Field Day. 2nd weekend. World SSTV Contest.
ARRL DX Contest—'phone, 1st weekend, CW 2nd weekend.
March. ARRL DX Contest—'phone 1st weekend
B A R T G. R T T Y Contest.
C Q WW PX SSB Contest.
Keep practising with the key . . . the "RD" is not far away.

SSTV AND OSCAR 6

WA9UHV, writing to Amsat about s.s.t.v. through the satellite, considers the best pictures are received when overhead passes are used. However, acceptable pictures are obtained when maximum elevation is 40 deg. This seems to be the minimum orbit required for full 8 second frames. ●

THE HISTORICAL DEVELOPMENT OF U.H.F. CIRCUIT TECHNIQUES

PART TWO

*ROGER LENNED HARRISON,**
VK2ZTB (ex VK3ZRY)

1930-1940: MAGNETRONS, KLYSTRONS AND WAVEGUIDES

In 1920, George Southworth, then at Yale University, stumbled on the effects of guided waves (see early part of Ref. 5). Soon after leaving Yale, he joined the Bell Telephone Company Research Department. During the ensuing eight years he worked at various projects mainly concerned with transoceanic telephony. Towards the end of this time he re-kindled his interest in the very new idea of guided waves.

Wave Guides. Late in the summer of 1931 he started a series of clandestine experiments with which he explored the basic principles of guided waves. He used both metal and dielectric circular columns in his experiments and explored the fields inside them at various frequencies. To reduce their physical size he filled them with a dielectric—water. Fig. 5 illustrates the apparatus he used. The actual experiments were not performed until March 1932.

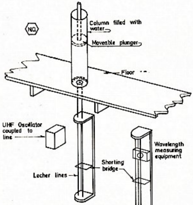


FIG. 5

Late in the 1920s several European research organisations attached to electrical engineering firms had been doing research into tube manufacturing with a view to producing tubes which would oscillate at extremely high frequencies. Several experimental types were produced which were capable of producing Barkhausen oscillations up to 2000 MHz.

Southworth obtained and put to use several of these tubes for his waveguide experiments. By the end of 1932, Southworth had identified and thoroughly explored the dominant transverse electric (TE_{11}) and circular magnetic (TM°_{01}) waves. With continuing experiments, this time with the knowledge and admission of the Bell Telephone Company, he developed the electromagnetic horn (a waveguide antenna) and later the waveguide transmission line in 1933.[6]

In developing the first waveguide transmission lines, George Southworth, plus assistants, developed a waveguide oscillator and waveguide receiver shown in Figs. 6 and 7. The detector in the receiver was a silicon crystal mounted in a polystyrene rod, very similar in construction to the "catswhisker" detectors used 20 years previously.

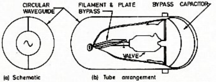
Southworth also investigated the characteristics of specific discontinuities introduced into waveguides and developed the waveguide filter. Assistance in developing these devices came from Mr. H. E. Curtis and Mr. N. C. Olmstead from Bell Telephone laboratories.

Measuring techniques had also to be developed along with the various circuit elements and the travelling standing-wave detector was developed as well as cavity wavemeters[9] (see Figs. 8, 9, 10, 11).

The Silicon Crystal. In 1936 Mr. R. S. Ohl, of the Bell Telephone laboratories, was given the task of improving silicon rectifiers as detectors. By introducing specific impurities into very pure silicon he produced both NP and PN junctions; and when investigating their characteristics discovered that the devices he developed had thermal and light-sensitive properties as well as improved electrical characteristics. These devices were subsequently developed into microwave detectors and ultimately into many things known as solid state devices.

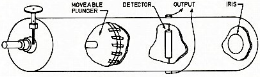
The Magnetron. Sometime after Barkhausen type oscillators were being used and the effects of electron transit time and electronic oscillation were becoming understood and accepted, several people embarked on projects aimed at developing high power at extremely high frequencies.

Notables in these first attempts were C. W. Rice (Britain) who produced a magnetron (Fig. 12) in 1936 capable of producing 3 watts at 5000 MHz.[10]

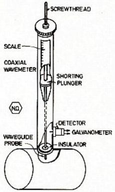


(a) Schematic (b) Tube arrangement

BARKHAUSEN OSCILLATOR IN WAVEGUIDE FIG. 6



EARLY WAVEGUIDE RECEIVER FIG. 7



WAVEGUIDE WAVEMETER BY BOWEN (1934) FIG. 9

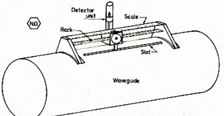
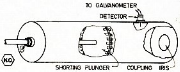
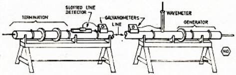


FIG. 8 – STANDING WAVE DETECTOR

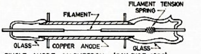


EARLY HIGH-Q CHAMBER (SOUTHWORTH) FIG. 10



TYPICAL SETUP OF 1934 INVESTIGATIONS FIG. 11

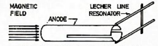
* P.O. Box 702, Darlinghurst, N.S.W., 2010.



SINGLE ANODE MAGNETRON (C.W. RICE 1936)
FIG. 12

The filament and the anode formed part of a co-axial line resonator.

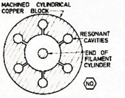
E. G. Linder (Britain) constructed an anode which formed part of a two-wire (Fig. 13) transmission line resonator. The concept of transmission lines as resonators, having come originally from Hertz and Lecher[3] was now well established and in fairly widespread use by Radio Amtaeurs.



MAGNETRON ANODE EMPLOYED BY LINDER FIG. 13

The techniques used in these early devices were copied and further developed in America.

On 21st February, 1940, the Physics Department of the University of Birmingham tested a magnetron in their laboratories which produced approximately half a kilowatt of power at 3000 MHz. The power input was kilowatts. This device was a tremendous advance over all the previous efforts and subsequent devices have only been refinements on this device. A diagram of the anode is shown in Fig. 14.[10]



ANODE USED IN FIRST BIRMINGHAM MAGNETRON FIG. 14

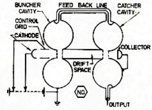
This, and subsequent devices, were developed with the aid of the General Electric Company who later produced magnetrons for service use during the war.

The Klystron. In 1935, two German scientists, A. Arsenjewa-Heil and O. Hiel published an article in which they suggested that the principle of velocity modulation of electrons could be used as a means of producing very high frequency oscillations. Some further theoretical work on the subject was published in 1938 by two other German scientists, Bruche and Recknagel, but it was not until 1939 when two American publications of independent developments brought forth microwave oscillators using the velocity modulation principle.

The publications of the Varian brothers and Hahn and Metcalf made significant strides in the development of microwave circuit techniques. The Varian brothers gave the name of "Klystron" to their device which employed velocity modulation of an electron beam and special types of cavity resonators for the two tuned circuits associated with the device. A diagrammatic representation is given in Fig. 15 (see Refs. 10, 11 and 12).

This device was subsequently developed into the reflex klystron which used only one cavity.

It appears that the decade, 1930 to 1940, brought forth most of the significant developments which established the basic principles of microwave techniques.



KLYSTRON OSCILLATOR WITH CAVITY RESONATOR FIG. 15

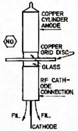
1939 TO 1945:

THE WAR YEARS

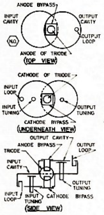
Radar. With the onset of war, first in Europe, then in America, an acceleration in scientific developments took place. In 1935, in Britain, Sir Robert Watson-Watt and a small team of co-workers laid the foundations of Radar. Subsequent developments, in Britain, America, France and Italy, improved the original techniques; but a stumbling block occurred which necessitated the use of much higher frequencies than 200 MHz. then in use.[10]

To overcome these difficulties the waveguide techniques of Southworth and his research team were exploited along with the klystrons and improved higher frequency magnetrons. The klystron of the Varian brothers was developed into the Reflex Klystron and used as a low power local oscillator or signal source in radar superheterodyne receivers.

U.H.F. The frequencies above 200 or 300 MHz. were now assuming some practical importance and techniques were developed and put into practice using the frequencies between 300 MHz. and 3000 MHz. Previously techniques for using these frequencies were purely experimental; now, lessons learned in the past were put to use.



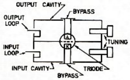
DISC SEAL TRIODE
FIG. 16



TRIODE AMPLIFIER FIG. 17

Efforts directed at extending the useful range of conventional valves by the logical suppression of their basic causes of inefficiency led to improvements like the disc-seal and grounded-grid triodes which function satisfactorily at frequencies up to 3000 MHz.[13]

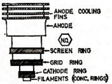
Figs. 16, 17, 18 and 19 amply illustrate the techniques developed for these frequencies.



UHF TRIODE AMPLIFIER FIG. 18

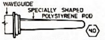
Antennas. Developments in the microwave field were many, rapid and had far-reaching applications. The demands of radar called for widely varying techniques to solve the various problems that arose. Waveguide techniques were extended into antennas and several people looked into the problem of developing a waveguide into an antenna.

In 1935 Dr's Barrow and Chu, of the M.I.T. (America) developed and explored the characteristics of sectorial and pyramidal horns. Also in that year A. P. King, of the Bell Telephone laboratories, experimented with conical horns and pyramidal horns. This research was taken up again in 1940 and 1941 by the people mentioned. The leaky guide antenna and the horn-parabola antenna were subsequently developed.



COAXIAL TETRODE FIG. 19

One fairly unique antenna that came from an idea originally investigated in 1920 by Otto Schriever and later by George Southworth was the polyrod antenna. This was developed from the idea of a dielectric waveguide and solved the problem of providing an antenna which "would give moderate directivity without occupying any considerable amount of broadside space".[6] An illustration is given in Fig. 20.

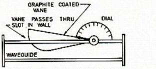


POLY ROD ANTENNA FIG. 20
(APPROXIMATELY 1941)

Also developed into practical, widespread use was the parabolic dish and its various truncated and sectorial sections. The optical properties of this antenna were first investigated by Hertz around 500 MHz. in 1888.[3]

Dr. J. D. Kraus (W8JK) did much investigation into a wide variety of antennas just prior to, and during the war. Most of these were for use in the region 50-3000 MHz.

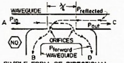
Circuit Elements. In 1941 the Radiation Laboratory was set up at the Massachusetts Institute of Technology and in this place many significant developments took place. The scientists and engineers working in this establishment modified, refined and further developed the techniques that were being developed at the Bell Telephone laboratories by Messrs. Southworth, Fox, King and Brown.



VANE TYPE ATTENUATOR FIG. 21

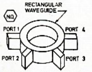
Amongst the devices developed by those two establishments were waveguide filters, including bandpass, bandstop and single frequency filters, fixed and variable attenuators, waveguide bridges (for even or uneven power distribution) and the magic-tee junction. The latter two devices were evolved by Dr. Tyrell (Bell labs.) in 1941 and have since been widely used in many applications. An outgrowth of these devices was the directional coupler evolved by W. W. Mumford (Bell labs.). This device has since seen widespread use also, mainly as a monitor and standing wave detector. Illustrations of some of these devices can be found in Figs. 21, 22, 23, 24.

Frequency limits were progressively pushed back and in 1942 10,000 MHz. radar sets came into general use for high definition radar. Experiments took place in the University of Michigan labs. with generating 28,000 MHz. (and above) energy by separating the harmonics produced from impressing energy on a silicon diode. Unfortunately power outputs were low.

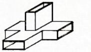


SIMPLE FORM OF DIRECTIONAL COUPLER FIG. 25

Main power goes from A to C, some is bled off down to D but none down to B. Reflected power goes from C to A, some is bled off down to B, but none to D. Useful for VSWR measurements

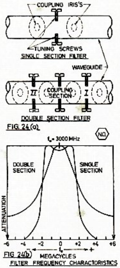


RING-FORM OF WAVEGUIDE BRIDGE (TYRRELL,1941) FIG. 22



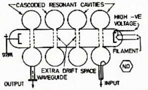
"MAGIC-TEE" WAVEGUIDE BRIDGE (TYRRELL 1941) FIG.23

Both of the above bridges act like a "hybrid" transformer.



WAVEGUIDE FILTERS AND CHARACTERISTICS FIG. 24

Microwave Amplifiers. The problem of microwave amplification, both of small signals and large signals reared its head relatively early in the war and variations on the devices developed by Hahn and Metcalf and the Varian Bros., also the Heil devices from Germany, were produced. Klystron amplifiers achieved some success, but output powers were limited until the idea of placing several cavities and drift spaces in cascade along the same electron beam was used and output powers increased enormously (see Fig. 26 for multicavity klystron).



MULTICAVITY POWER KLYSTRON FIG 26

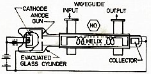
These devices were essentially narrow band devices and thus were suited only to particular applications.

Travelling Wave Tube. In a paper published in the "Proc. I.R.E." for Feb. 1947, Rudolf Kompfner, indicated that sometime prior to April 1943, he proposed the travelling wave amplifier and proceeded to immediately build working models. These were fairly well developed by the end of 1949.

With these devices it was possible to achieve gains of over 30 dB. over a bandwidth of 800 MHz. at a centre frequency of 3600 MHz. They could be constructed for low noise, wideband, small signal applications or for wideband power amplifiers capable of producing several watts output power.[13] An illustration is given in Fig. 27.

It is obvious that World War II. greatly accelerated the development of u.h.f. circuit techniques right throughout the portion of the spectrum spanning 30 MHz. to 30 GHz. Comparing the circuit techniques shown in the various diagrams for this period with the diagrams for the two decades preceding the war makes this fact plainly obvious. ●

(to be concluded)



TRAVELLING WAVE AMPLIFIER FIG. 27

Wave power to be amplified is passed along a helix through which an electron beam is projected.

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THE W.I.A. SUBSCRIPTION YEAR RUNS FROM 1ST JANUARY TO 31ST DECEMBER

New Members' Subscriptions Run to 31st December of the Year in Which They Joined, But Where a Full Year's Subscription is Paid When Joining This Runs Only for One Year. A Balance is Payable in Such Cases for the Following Year Based on a Pro-rata in Terms of Months up to 31st December of That Year.

BUILDING HIGH-Q INDUCTORS WITH FERRITES

BY A. G. BIRCH, VK3ZRQ*

• Following on from his recently published series of articles on Filter Design, VK3ZRQ gives in this article the information necessary to achieve desired values of inductance and Q for such filters, using ferrite pot-cores.

INTRODUCING THE MATERIAL

Ferrite materials are a homogeneous compound of FeO (an oxide of iron), with one or more metallic oxides, in a cubic crystal structure. In general, they are a non-metallic ferro-magnetic material with useful resistivity and low co-ercivity, made by a ceramic process. Thus these materials have a higher permeability than older materials, lower losses over a wide frequency range, and the inductance can be readily trimmed, in final adjustment of a filter, by means of a small rod inserted axially through the air-gap.

For the physics-minded it can be stated that to achieve the high initial permeability (necessary because inductance is proportional to permeability) and low hysteresis loss, the material structure must be free of stresses. This only occurs with a cubic crystal since only then is the cooling shrinkage equal in all directions—important when sintering temperatures between 1,000 and 1,400°C. are involved.

The commonly available ferrites are mixed crystals of manganese-zinc (Mn-Zn) and nickel-zinc (Ni-Zn). As a side interest, they crystallise with the characteristic structure of the spinel, beloved of amateur gem-collectors.

Uses of the Different Types

Trade terminology identifies the main ferrites with a number-letter classification associated with a particular frequency range:—

Mn-Zn, 3B material:
1 kHz. to 500 kHz.
Ni-Zn, 4A-4E material:
500 kHz. to 50 MHz.

Usual Specifications by the User

What we most commonly want to choose are the following:—

Inductance, L;
Operating frequency: f;
Quality factor: Q;
A.c. coil current: i (when used, this particular loss is calculated for an arbitrary 1 mA. because it is dependent on i).

PRACTICAL DETAILS

We need to either select or calculate the following:—

1. Grade of ferrite material—selected by frequency rating;
2. Size of pot-core—selected via guide lines to follow;
3. Size of air-gap—to enable ordering pre-gapped cores;
4. Wire size, number of turns, and copper space-factor f_{CU};
5. Estimate the actual Q-value—it generally turns out to be not more than 10-15% high.

* 5 Harrison Street, Bendigo, Vic., 3550.

Q-Factor Estimation

A knowledge of this is necessary as a guide to the performance to be expected. In practice, you will find that quite adequate performance in filters can be obtained with a Q-value as low as 50-80 for the coils.

It will be found that below about 5 kHz., Q-factor can be simply calculated in only one step, since only resistive winding loss is significant. Beyond about 50 kHz. we need to calculate all five losses as follows, but this is fortunately simplified by values provided by the different manufacturers.

Since this is only an introductory note, we can further thin out the forest of choice by restricting ourselves to only one or two cores, and the writer's own experience has been that one particular size will satisfy a wide range of common needs.

The Q-value is found from a loss-calculation.

LOSS-CALCULATION

Each of the losses may be considered as a resistance in series with a loss-free coil and expressed, most conveniently, as a ratio R/L ohms-per-henry. Hence if we add up all the R/L values and divide into 6.28f, we have the estimated value of Q as: $Q = 6.28\ f\ (L \div R)$. This will generally turn out to be not more than 10-15% different from the actual value at the lower audio frequencies. The condensed form of these loss-factors is given below—some of them can be derived from theory, others have to be approximated from research laboratory measurements.

The losses may be divided into two groups, namely winding losses and core losses.

Winding losses:
(1) D.c. resistive (Ro);
(2) Winding eddy current loss (Rcu);
(3) Dielectric (parallel capacitance) loss (Rd).

Core losses:
(4) Hysteresis (Rh);
(5) Residual and eddy current losses (Rer).

For the 26/16 core using 3H1 material, we find:

$$(1)\qquad \frac{R_O}{L} = \frac{7420}{\mu_E\ f_{CU}} \text{ ohms/henry}$$

$$(2)\qquad \frac{R_{CU}}{L} = \frac{480}{\mu_E} f_{CU}\ d^2\ f^2$$

$$(3)\qquad \frac{R_D}{L} = [(2 \div Q) + 0.01]\ f^3\ L\ (52.1 \times 10^{-10})$$

$$(4)\qquad \frac{R_H}{L} = 800\ \mu_E\ I\ f\ (L \div N)$$

$$(5)\qquad \frac{R_{ER}}{L} = [(1.5 \times 10^{-6}) - (3 \times 10^{-12}\ f)]\ (6.28)\ f\ \mu_E$$

where μ_E = Effective permeability.
f_{CU} = Copper space factor.
f = Hertz (cycles/sec.).
d = Wire diam. in metres (mm. ÷ 1,000).
L = Henrys (mH. ÷ 1,000).
I = Amps. (mA. ÷ 1,000).
N = Turns.

Below about 4-5 kHz., only the first equation need be used.

Effective Permeability = μ_E is related to the tolerable temperature-caused change of inductance by what is called a temperature factor (T.F.).

$$\mu_E = \frac{\text{Fractional Change of L}}{\text{T.F.} \times \text{Temp. Range}} - 20$$

For the core specified above, T.F. $= 1 \times 10^{6}$.

Accepting that for non-precision purposes, a change in L over a liberal temperature range of 50° Celsius (5° to 55°) not more than 1% will be tolerable, the equation reduces to

$$\mu_E = \frac{1 \times 10^{-2}}{1 \times 10^{-6} \times 50} - 20 = 180$$

A higher μ_E can be used, but the change of L will then be greater.

GUIDE LINES

A high inductance requires a great number of turns and thus also a large volume if the losses are to be kept to a reasonably low figure by not using a very fine wire.

If the calculated Q turns out to have an unnecessarily large value, this amounts to an instruction to try the next smaller core.

If too small an air-gap is used in an endeavour (by increasing μ_E) to get high Q, then ageing effects cause L-value to change more over a period of time.

If too large an air-gap is used (in order to ensure that the coil inductance will not change significantly when temperature rises), we need a larger number of turns for given L, and again a larger volume or size of core.

CALCULATION PROCEDURE

1. From above discussion, $\mu_E = 180$ to give a temperature stability good enough for non-precision purposes.

2. This permeability value will be obtained (from Curve A of Fig. 1) with an air-gap of 0.2 mm. (approximately 8 thous.).

3. Curve B of Fig. 1 gives the number of turns/mH. $= 45 = \propto$.

4 (a). $N = \propto \sqrt[2]{L}$, so number of turns for the coil: $N = 45 \sqrt[2]{2.5} = 71$. This would be, within a couple of percent., the number of turns on a 26/16 single-section coil former to give the required L = 2.5 mH.

(b) Inductor adjustment: Since the slug will only raise the L-value, we calculate N for a value of L reduced

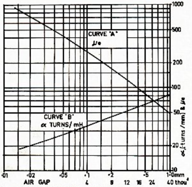

FIG 1 CURVES FOR 3B7 AND 3H1 MATERIAL

by 5%—this allows the slug adjuster to trim L by ±5%.

Thus we use N = 68 turns.

5. **Wire Size**: Table 1 gives the number of turns of any wire size that will just fill the bobbin. Line 16 suggests B. & S. 22 gauge will fit 79 turns on to the bobbin. We need only 68, so the real space factor will be about $68 \div 80 \times 0.55 = 0.47$.

ENAMELLED COPPER WIRE			
	Wire Diameter		
B. & S. No.	mm.	inch / 1000	Turns, N
38	0.10	4 thou"	2500
36	0.12	5	1750
35	0.14	5.5	1200
34	0.16	6.5	1040
33	0.18	7	770
32	0.20	8	680
31	0.22	9	605
30	0.25	10	435
29	0.28	11	382
28	0.32	13	270
27	0.35	14	225
26	0.40	16	170
25	0.45	18	150
24	0.50	20	115
23	0.55	23	97
22	0.65	25	79
21	0.71	28	63
20	0.85	33	51
19	0.95	37	41
18	1.06	41	34

TABLE 1.—HIGH-Q INDUCTORS

Number of turns and wire size to fill the bobbin for 26/16 core, copper space-factor $f_{CU} = 0.55$.

6. **Loss Estimation**: For a single-section 26/16 bobbin we can show that:

$$\frac{R_o}{L} = \text{resistive copper loss}$$

$$= \frac{7420}{\mu_E\, f_{CU}}$$

$$= \frac{7420}{180 \times 0.47}$$

$$= 88 \text{ ohms/henry.}$$

$$\text{Thus find } Q = \frac{6.28 \times 5{,}000}{88}$$

$$= 350$$

(This, in fact, is about 40% above a more accurate value; see Appendix.)

7. **Other Values of L** (and corresponding Q): Table 2 gives a short list of standard pre-gapped cores with their μ_E and $\propto$ values. Using a high-μ_E core implies a looser temperature-stability of inductance.

Permeability μ_E	Turns/ mH. $\propto$	Air-gap g
15	146	4 mm.
22	120	3 ,,
33	98	2 ,,
47	82	1 ,,
68	68.5	0.7 ,,
100	56.5	0.4 ,,
150	46	0.24 ,,
220	38	0.15 ,,
330	31	0.07 ,,
730	21	0.02 ,,

TABLE 2.—HIGH-Q INDUCTORS

Pot-cores with standard μ_E values and corresponding turns/mH. values.

Typical construction of pot-cores is shown in Fig. 2, as manufactured by Philips and Siemens.

For L = 36 mH., with the same core as above,

$$N = 45 \sqrt[3]{36} = 270.$$

Choose, from Table 1, B. & S. 28 wire, which could fit 320 turns on the former.

Wind only 270, and find the real $f_{CU} = (270 \div 320) \times 0.55 = 0.47$. Since this is the same as before, Q still = 300 (approx.).

If we have only 22 B. & S. we might try a higher μ_E (which would give poorer temperature stability), and with $\mu_E = 300$, we would find $\propto = 31$, giving $N = 31 \times 6 = 186$.

The best compromise (to avoid two wire sizes) would be B. & S. 26 which would give 170 turns on the former and be still 10% low when trimmed with the adjuster.

Alternatively, we could use 28 B. & S. on the 2.5 mH. former, and tolerate the poor space factor (0.20), and find the Q-value (now dropped to 150) still acceptable.

However, 4 ozs. each of (say) three sizes of wire will wind a number of these coils and only cost about a dollar.

To obtain the inductance more flexibly, a simple hand-made brass or aluminium tool used with a smear of 400-grit Si. carbide will remove about 1 thou. of material from the centre post in about 1 minute or less by hand. Check the increase in gap size by micrometer and read off the new $\propto$ and μ_E value from the chart, then proceed.

MOUNTING INSTRUCTIONS

Remove all dust from the core with a dry brush and wipe with cleaning fluid to remove grease.

Cement the coil halves with Araldite film, and leave under a weight about that of two building bricks for at least 1 to 2 days. Alternatively, cure in an oven at **not more than 100°C.** for about two hours, under about the same weight.

Mounting cases are available so that the core-halves need not be cemented (unless desired for severe shock and vibration conditions).

Pre-adjusted cores can be supplied already fitted with a nut for the inductance adjuster cemented into one of the core-halves.

The adjuster is screwed through the pot-core into the nut and is held in position by the lips of the adjuster head. The adjuster always increases L-value, and can do so to within 1 part in 1,000.

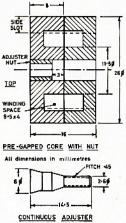

FIG 2 TYPICAL POT CORE

CONCLUSION

By the foregoing procedure, the inductances for two filters of the last article turn out to be as in Tables 3 and 4.

All coils are wound on 26/16 cores with 3H1 material, single-section bobbins, and Lewcomex enamel wire for heat-removable coating. The fixed quantities are $\propto = 46$ turns/mH. for the core with $\mu_E = 150$, which has a pre-set air-gap of 0.009 inch.

Inductance mH.	B. & S. No.	N Turns	Q
L1 = 44.3	28	305	220
L2 = 52.4	28	330*	245
L3 = 24.7	28†	228	175

* 320 turns will give 47.5 mH. with 10% error. Adjusting slug should reduce this to about 1 or 2% error.

† B. & S. 27 would fill bobbin, but available B. & S. 28 only decreases Q-value.

TABLE 3.

5th Order Equal-Ripple Filter

APPENDIX

Full-loss calculation for 2.5 mH. coil at 5 kHz. = f.

$$(1)\quad \frac{R_o}{L} = \frac{7420}{180 \times 0.47}$$

$$= 88 \text{ ohms/henry.}$$

$$(2)\quad \frac{R_{CU}}{L} = \frac{480}{180} \times 0.47 \times 5^2 \times 10^6 \times 3.5^2 \times 10^{-8}$$

(for 27 B. & S. wire, diam. = 0.35 mm.)

$$= 2.7 \times 25 \times 0.47 \times 12.2 \times 10^{-2}$$

$$= 3.9 \times 10^{-2} \quad \text{(negligible)}$$

(Continued on Page 19.)

VARACTOR TUNED BFO

BY R. J. CALLANDER, VK3AQ*

• This is a simple, stable, economical, easy to build varactor tuned BFO (455 kHz. ± 5 kHz.). It was originally built to help Y.R.C.S. members resolve s.s.b. signals and also receive Morse Code.

This b.f.o. is not affected by hand capacity like most b.f.o's and no metal shielding is required. In fact the metal can around the i.f. transformer (i.f.t.) had been removed so that a link coupling coil could be wound around the i.f.t. and connected to a large coil around the short wave set.

Tuning the b.f.o. ± 5 kHz. is done by a 5K linear pot. (2-100K can be tried out if available) and the voltage change across the transistor in the b.f.o. alters the internal capacity of the base collector junction and this varies the frequency.

B.F.O. CIRCUIT

See Diagram A.

1. Midget transistor type i.f. transformer used—remove metal can first before soldering i.f.t. into circuit.

Put the 5 ohm coil in collector circuit; 1 ohm coil in emitter circuit.

Try reversing connections to either coil (but not both) if the b.f.o. won't oscillate.

Don't use the tap on the 5 ohm winding.

See if there is a condenser built into the base of the i.f.t. If not, put a 330 pF. across the 5 ohm winding (Styroseal best).

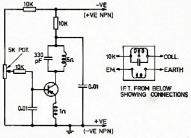

DIAGRAM A

2. Type of transistor—best to use r.f. transistor, although audio transistor will often oscillate.

Collector must be **positive** with NPN transistor; collector must be **negative** with PNP transistor.

3. 5K **linear** pot (try 2-100K if you have one handy). Wire 10K resistors direct onto the pot so that when pot is turned clockwise the wiper arm goes to 10K resistor and not 9v. (see Diagram B).

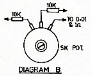

DIAGRAM B

* 383 Warrigal Road, Burwood, Vic., 3125.

4. Other parts required are:
0.01 μF. disc condenser (two);
10K resistor (three);
300 pF. Styroseal if your i.f.t. needs one;
9v. battery;
Veroboard or printed circuit.

LINK COUPLING COIL BETWEEN B.F.O. AND SET

(See Diagram C). Use a piece of thin insulated wire about 4-6 ft. long. Take the middle of the wire and wind two or three turns tightly about the i.f.t. (can removed). Then twist the two leads together and lead out towards the short wave set and make a larger loop to go around the s.w. set or of valve or i.f. transistor or aerial input lead. Solder ends of the wire together so you have a continuous loop.

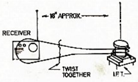

DIAGRAM C

TESTING YOUR B.F.O.

Having built your b.f.o., probably from the complete kit put out by the Y.R.C.S., proceed to measure the resistance across the positive and negative leads (with the battery not connected). It should be several thousand ohms and not a short circuit. Then with a milliammeter in one of the leads connect up the 9v. battery (positive to collector circuit for NPN transistor) and the b.f.o. should draw about 1 milliammeter.

Tough the collector with your finger and if it is oscillating the current should rise slightly.

You could also measure the voltage across the base-emitter junction and if the b.f.o. is oscillating the voltmeter will read backwards.

If you don't have a milliammeter connect up the link coupling coil between i.f.t. or b.f.o. and s.w. set, and listen for a strong signal as you tune between 3AR and 3DB—the b.f.o. will be oscillating on its second harmonic.

GETTING THE B.F.O. ON 455 kHz.

Connect up the link coupling coil between the b.f.o. i.f.t. and broadcast range on set. Set the 5K pot to the middle of its range. Then screw the slug in i.f.t. of the b.f.o. in or out until you get a **very loud** whistle on **all** stations on broadcast on s.w. bands. This applies only if your set has a 455 i.f. frequency, but this is the frequency most single conversion sets employ—turning the pot to right or left should alter the whistle as you alter the frequency. This should happen on all stations if you are on the i.f. frequency.

Turn pot clockwise from centre positions — this changes 455 to 450KHZ approx., and this is where you resolve your lower side band signals such as 40M and 80M. Turn pot anti-clockwise from centre position — this changes 455 to 460 KHZ approx. and this is where you resolve your upper side band signals such as 20 and 15 M.

The 5K pot varies the base bias which alters the collector current and thus the voltage drop across the resistor in the collector circuit. Thus the voltage across the collector — base junction varies as you rotate the pot and this gives rise to a varactor diode effect which alters B.F.O. frequency. You can mount the pot resistors directly on the pot and this makes the B.F.O. board less crowded.

HOW TO RESOLVE SSB SIGNALS ON YOUR SW SET

In an SSB signal only one side band is transmitted (upper side band in case of 15M and 20M, lower side band in case of 40M and 80M). The carrier is suppressed at the transmitter and the BFO re-inserts the carrier in the receiver but it must be re-inserted carefully in correct relationship to the upper or lower side band being transmitted.

1. First switch **off** the B.F.O. and tune in the duck talk for the loudest signal (there will be no carrier to tune into, so wait until the operator is talking).
2. Switch **on** B.F.O. and connect up the link coupling coil. Alter the 5K pot slowly only while operator is talking.
   Rotate clockwise for 40 and 80M SSB.
   Rotate anti-clockwise for 20 and 15M SSB.
3. The louder the SSB signal the more BFO carrier re-insertion is required —place the large loop close to the set and as a last resort remove the aerial from SW set if the SSB signal is in the next street (this attenuates the SSB signal). The weaker the SSB signal the less B.F.O. injection is needed, so move the larger loop further away from the SW set. If it is too close it will deaden the set (and the weak signal) by its action on the AVC circuit.
4. Mount the B.F.O. in a small plastic box (such as Kodak slide box) and bring out the link coupling loop.
5. Your BFO will also enable you to receive morse code.
6. Kits for this BFO complete with a printed circuit board are available from YRCS (contact VK3AQ) at a most attractive price of $2.
7. Don't forget to switch off when you have finished. ●

THE W.I.A. SUBSCRIPTION YEAR RUNS FROM 1ST JANUARY TO 31ST DECEMBER

THE QUARTER WAVE AND FIVE-EIGHTH WAVE ANTENNA FOR TWO METRE MOBILE

BY GRAEME DOWSE,* VK2AGV

● This is not a constructional article, but by understanding how and why it works, and applying a small amount of commonsense, especially on the mechanical side, you should be able to get the best out of your present system.

Question: Why do some people use $\frac{5}{8}$ wave whips instead of the good old simple $\frac{1}{4}$ wave?

Answer: Simple . . . it works better.

It has a **theoretical** maximum gain of 3dB over a quarter wave on both transmit and receive, but only if properly matched to the transmission line (co-ax).

Considering that one S-point constitues a 6dB change in signal strength, half an S-point is gained over the $\frac{1}{4}$ wave. If a comparison is made between 2 mobiles both using $\frac{1}{4}$ wave. then both using $\frac{5}{8}$ wave whips, the received signal is one S-point better in both directions in favour of the $\frac{5}{8}$ wave whip. This may not sound much, but, remember that it is still an omnidirectional antenna, so any gain that can be obtained is worth the effort.

In fact, not one, but many S-points of difference were observed when making these comparisons.

A point quite often neglected by 2 metre FM operators is that a fairly weak signal — on the "guessmeter" say, 5 x 5 — when increased by only 3dB produces a remarkable improvement in signal-to-noise ratio. A 6dB increase can produce an almost noise-free signal from the loudspeaker and, in the absence of an S-meter, one could be excused for saying that the signal is now 5 x 8 or 5 x 9. This abrupt change in apparent signal strength is due to what is called the "threshhold effect" of an F.M. receiver, and is much less apparent on the other modes. The narrower the band width of an F.M. receiver, and the better the front end is, the more pronounced is this effect, vhich will occur at a lower signal level. Note that the threshhold effect does not apply when slope detecting F.M. signals.

Question: Some amateurs are heard using a ground plane instead of a whip on their car. Some say that it performs better than a whip. Why?

Answer: There should be no difference in performance between a ground plane aerial and a whip mounted on a large flat metal surface such as the roof of a car. The metal roof does the same job as the radials on a ground plane antenna.

However, for reasons best known to themselves — or their XYLs — many amateurs do not favour the idea of drilling a hole in the car roof in which to mount a whip. A suitable alternative is to make use of a luggage rack or surfboard rack and mount the whip on this. Unfortunately the radiation pattern will be distorted because of the uneven ground system directly below the whip. This can be corrected by adding radials at the base of the whip, making it into a ground plane antenna. When a board rack is used only two radials need to be added, running north-south. The east-west ones being the rack itself. Radial length is not important, minimum length being $\frac{1}{4}$ wave.

Any improvement in performance of the ground plane antenna over a roof-mounted whip will only be because of the few inches extra height above ground given by the roof rack.

The above applies to both $\frac{1}{4}$ and $\frac{5}{8}$ wave systems. A point worth noting is that a whip mounted on a vehicle will work best in the centre of the roof, being the highest point above ground and having the largest flat area of metal surounding it. A gutter-mounted whip doesn't work as well. The disadvantages are that it will be directional (usually in the direction of maximum metal, i.e. across the car). Also it is difficult to determine the base impedance because of the uneven ground system, making matching to the co-ax a problem. A mudguard-mounted whip has these problems plus the extra disadvantage that it is closer to the ground, where signals are weaker and noise level—car ignition, &c.—is higher. Also there is some shielding effect of the cabin on the car.

However, the mechanical advantages of mudguard and gutter whips are obvious and may outweigh their electrical disadvantages, especially on larger vehicles.

Note that placement of a $\frac{5}{8}$ whip is less critical than that of a $\frac{1}{4}$ wave because of its larger physical size by comparison with the irregular shape and size of the vehicle below it. For instance, the difference in overall performance between a $\frac{1}{4}$ wave in the centre of the roof and a $\frac{1}{4}$ wave on the gutter will be more noticeable than the difference between a $\frac{5}{8}$ on the roof and a $\frac{5}{8}$ on the mudguard or gutter.

A $\frac{1}{4}$ wave on the mudguard will have a more irregular radiation pattern than a $\frac{5}{8}$ wave in the same place.

Question: How can a $\frac{5}{8}$ wave aerial have more gain than a $\frac{1}{4}$ wave one? How can any omnidirectional aerial have gain?

Answer: Aerial gain and directivity are closely related. An aerial can have gain only in a specified direction and only at the expense of having a loss in other directions. When we say that a mobile aerial is omnidirectional we mean in a horizontal plane only. It is far from omnidirectional in the vertical plane, and you can see from the diagrams that most of the signal sent from a $\frac{1}{4}$ wave aerial goes upwards at an angle of about 45°. This R.F. is wasted unless we want to talk to aeronautical mobile stations!

By lowering the angle of radiation, less signal goes up and more of it goes out in a concentrated beam along the ground where the other stations are.

It follows that the signal from a low angle radiator will go further before they get weak.

A $\frac{5}{8}$ wave aerial will receive low-angle signals better than those coming from the sky. Its "capture angle" covers the area where signals emanate from.

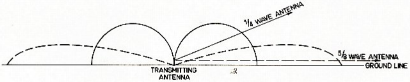

FIG. 1

The solid line shows the radiation pattern of a $\frac{1}{4}$ wave aerial showing most of the signal going skyward.

The dotted line represents the low-angle signal radiated from a $\frac{5}{8}$ wave aerial at the same location and using the same power.

Question: How long is a $\frac{5}{8}$ wave whip?

Answer: It can be shown by experiment that as the length of a vertical antenna is increased above $\frac{1}{4}$ wave-length its angle of radiation reduces until $\frac{5}{8}$ wavelength is reached. Longer than this results in the main lobe becoming broken up into smaller ones, and average angle of radiation increases, causing the horizontal gain to drop. The optimum **physical** length of a vertical radiator is $\frac{5}{8}$ of a wave-length for maximum gain in the horizontal direction. There are other types of arrays which give an even lower angle and more gain, such as the $\frac{7}{8}$ wave capacitive loaded vertical, or multiple element vertical array, but because of their size are not really suitable for mobile use. Note that the exact length is important, and any change here is bound to affect gain.

There are some local manufacturers who make "high gain" mobile aerials for commercial use. At least one of these companies will make these to order for any frequency in the 2 metre amateur band. The high gain aerial is not a $\frac{5}{8}$ wave but is in fact $\frac{3}{4}$ wave-length long. Its gain is slightly lower than the $\frac{5}{8}$ but is easier and less critical to match to 50 Ω co-ax.

The physical length of a $\frac{5}{8}$ wave whip is affected slightly by its diameter. A

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large diameter whip will be slighlty shorter, but lets not start splitting hairs.

The length of a ¼ inch diameter ⅝ wave whip can be calculated from the formula:—

Length (in.) = 7010 ÷ frequency (MHz)

For 146 MHz this works out to be 48 inches. This is the length measured from the top down to the point where it joins on to the matching system, or loading coil. Any matching system or loading coil which is mounted at the base of the whip should be kept physically as small as possible consistent with ruggedness, and placed as close as possible to the point of entry of the co-ax, so as to avoid interference with the whip's radiation pattern.

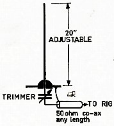


FIG. 2

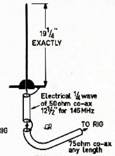


FIG. 3

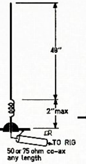


FIG. 4

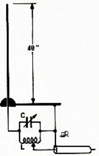


FIG. 5

Matching:

First, a few words about the quarter wave. The resonant length of a ¼ wave whip at 146 MHz is 19¼ inches. When mounted on a good ground its base impedence will be 39 Ω, resistive with no reactive component. If 39 Ω co-ax is used the s.w.r. will be 1:1 and highest possible efficiency will result.

However, 39 Ω co-ax is not easy to come by, but 50 Ω stuff is abundant. Besides which most transceivers are designed to work into 50 ohms. The mismatch by using 50 Ω co-ax is small, and an s.w.r. of better than 1.5:1 should result. If the whip length is increased by about an inch the resistive component at its base increases to a value approaching 50 Ω. The whip will now show a slight inductive reactance because it is now not resonant. The result is a better s.w.r. This is desirable because the transmitter can deliver more power into a low s.w.r. than it can get into a higher one. Note that it is impossible to get a perfect s.w.r. using 50 Ω co-ax and a ¼ wave whip, unless a matching system is employed.

One way is to use a slightly lengthened whip and tune out the residual inductance by inserting a variable series capacitor at the base of the whip. Fig. 2. Adjusting whip length and capacitor value alternately while watching s.w.r. will eventually give a perfect match at 50 ohms. The same method may be used with 75 Ω co-ax, the whip being longer still with a lower value for the series capacitor.

Fig. 3 is another way of getting a good match to a ¼ wave whip with 75 Ω co-ax. It makes use of an electrical quarter wave of 50 ohm co-ax connected between the 75 ohm co-ax and the base of the whip. This is a co-axial transformer which very nicely transforms the 39 Ω aerial impedance to 75 Ω.

The good old gamma match is ideal for matching a resonant ½ wave antenna to any co-ax, but is not so easy to make for a mobile set-up.

Matching the ⅝ Whip

A ⅝ whip alone is not much better than the proverbial wet string because it is not resonant and won't absorb much power from the transmission line. Resonant aerials come in multiples of a quarter wavelength. The nearest resonant length to ⅝ wave is ¾ wave. The idea is to fool the RF into seeing a ¾ wave antenna so it will be absorbed from the co-ax and radiated. This can be done as in Fig. 4 by adding an extra ⅛ wavelength of wire in series with the base of the whip and reducing it in size by winding it up into a coil. Another approach is to determine the impedance at the base of a ⅝ whip and build a tuning unit which will transform this impedance down to that of the co-ax. Fig. 5.

The impedance at the base of a ⅝ whip is high and capacitively reactive. In the inductively loaded whip, the coil is adjusted so that it tunes out the capacitive reactance so that resonance is obtained.

The impedance at the base of a ¾ wave at resonance is about 65 ohms resistive. The impedance at the base of a loaded ⅝ whip at resonance is, of course, about the same. For a 1:1 s.w.r. the co-ax impedance should be 65 ohms. When using 50 Ω co-ax the mismatch represents an s.w.r. of 1.3:1. Using 75 Ω co-ax would give an s.w.r. of 1.15:1. In practice these figures are difficult to achieve and one should strive for something like 1.5:1 and 1.2:1 respectively.

If a choice of co-ax is available, it is obvious that the loaded ⅝ whip will work better with 75 Ω co-ax. In each case the coil is adjusted for lowest s.w.r. by winding on slightly more wire than necessary, then shortening out sections of a turn at a time until s.w.r. is at minimum. Shortened turns will have no effect on performance at all. The finished coil should be weatherproofed, otherwise rain water between the turns will have a rather detrimental effect on s.w.r. in wet weather.

For the perfectionist, lowest s.w.r. on any co-ax can be obtained using a tuning unit just below the base of the whip as shown in the diagram. This can be mounted behind the headlining of a car of, or inside a weatherproof box forming the base of a groundplane antenna.

C is a 0.5 to 3PF TV tuner type trimmer and L is 4 turns 18 gauge tinned copper wire (preferably silver plated) tapped one turn from the earthy end for 50 Ω and 1½ turns for 75 Ω co-ax. Diameter is ⅜". Lowest s.w.r. is obtained by adjusting the trimmer and the exact tap position alternatively. When using this type of matching it is important that a low loss low capacitance mount is used because of the high impedance at the base of the whip. This system will give the ultimate performance from a ⅝ whip.

NOTES ABOUT S.W.R. BRIDGES

You can't use a 50 Ω s.w.r. bridge on 75 Ω co-ax and vice versa. There are commercial bridges which have a switch for either 50 or 75 ohms.

Some commercial bridges have an upper frequency limit of around 150 MHz, so measurements made around 146 MHz may not be as accurate as they might have been on 6 metres.

I can think of two ways of checking an s.w.r. bridge. One way is to borrow another one, preferably the same type, and connect them in series about an electrical ½ wave apart in the co-ax to a dummy load or good antenna. Both meters should read the same reflected power. If they don't then the one furthest from the transmitter is actually changing the s.w.r. seen by the other one. This means that the bridge is not suitable for use at this frequency, or the impedance of the bridge is not the same as that of the co-ax being used.

An excellent check is to connect up a low power transmitter to the input and a carbon resistor with short leads directly to the output of the bridge. For 50 Ω you could use 2 100 ohm 1 watters in parallel, and for 75 ohms 2 150 ohm units will do. A bridge terminated with its correct characteristic impedance should read zero reflected power. When the resistor is removed the forward and reffected power should read the same. Any length of co-ax can be used between the bridge and the resistor, and if the co-ax is good and of the right impedance, the reflected power will still be zero.

If an aerial is now connected instead of a resistor, the reading shown should be correct. If the s.w.r. is very high it will vary each time the co-ax is changed in length by ¼ wave. It is always a good idea to have handy an electrical ½ wave of co-ax with male and female connectors (about 12½ inches long for 146 MHz). If the co-ax is truly flat (very low s.w.r.), no difference will be noted by connecting the extra ½ wave of co-ax between the bridge and the antenna. Any length of co-ax may be used.

If you have to put up with a bad s.w.r. then it is wise to use an exact number of half wavelengths (25 inches) of co-ax between aerial and transmitter. The impedance at the base of the aerial is reflected at each half wave point along the co-ax, so this is what the transmitter sees. The losses in this system are higher, so it is always better to strive for lowest possible s.w.r.

Flutter

Flutter on a mobile signal is caused by the direct signal and reflected signals from buildings, hills or other large objects, arriving at the receiver at different times and different phases. These signals are continually changing in phase and strength with relation to one another, due to the changing position of the mobile signal source. At any particular instant any two signals striking the receiving antenna may cancel out or reinforce each other depending on their phase relationships. This leads to very large changes in signal strength coming from a mobile station, particularly if there are large obstacles between or near the two stations working.

Flutter is there all the time — you can see that on an S-meter—but is only heard when the lowest points in signal strength fall below the threshold level of the receiver where noise can be heard.

An increase in power or aerial gain will reduce flutter because the average received signal will be stronger so more of the signal will be above receiver threshold.

Obviously then a $\frac{5}{8}$ wave aerial will have less tendency to cause flutter — or receive it — by comparison with a $\frac{1}{4}$ wave, simply because of its extra gain.

One disadvantage of a $\frac{5}{8}$ aerial is that when travelling at high speed it will bend over to some extent under wind pressure. If the bending is excessive the lobe pattern will give a maximum in the upwards direction to the front of the vehicle and downwards towards the back, and tilted on both sides. This will reduce the signal strength at any point around the vehicle at a given distance. Under these conditions the $\frac{5}{8}$ wave may not give as good results as a $\frac{1}{4}$ wave. Flutter will be more pronounced because of lower gain and the odd angles at which the signals are emitted.

See Fig. 6, which shows how the lobe pattern of a $\frac{5}{8}$ aerial distorts when the aerial bends under wind pressure.

A good $\frac{5}{8}$ whip must be rigid enough to remain vertical within about 15 degrees whilst travelling.

Comparing Difference Between Aerials

When using another station with an S-meter to make comparisons between signal strength from different mobile aerials it is a mistake to remain stationary in one place. It is best to find a car park, paddock or wide driveway which is flat and clear of obstacles. With the transmitter on, drive around in a complete circle so as to finish up at the same place. Have your friend note the maximum, minimum and average signal strengths on his S-meter. It is amazing how much variation there will be.

Change over to the other aerial and do the test again. Comparison of results will clearly show up any changes in gain and directivity of the two aerials.

6 Metres, Too !

If you cut a $\frac{5}{8}$ whip down by $1\frac{1}{2}$ inches to $46\frac{1}{2}$ inches and compensate electrically by adding more wire to the loading coal, it will give an s.w.r. of better than 1.5:1 on both 146MHz and 52.525 MHz. It operates as a shortened quarter wave base loaded on 6 metres. Use only 50 ohm co-ax, otherwise the matching will be out on 6 metres. This is a compromise aerial on both bands, but has been in use for a year on the author's car and works well on both bands. ●

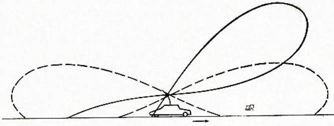


FIG. 6

NEWCOMER'S NOTEBOOK

With Rodney Champness,* VK3UG

This month something a bit different — a review of a simple BFO to add to your receiver. You may have noticed that the YRCS has recently advertised a small inexpensive BFO kit, for the princely sum of two dollars, and if you want it posted add 30 cents.

Ron Fisher, of Commercial Kinks fame, has one fitted into a multiband transistor portable radio. That will give you an idea of its size, about 1" x ½" x ½". As with any BFO, a tuning control is incorporated, but Ron found that the size of the control was almost greater than the BFO and there wasn't enough room to fit the control. Ron is satisfied to have the BFO preset for lower sideband. The performance of the set on lower sideband on the 160, 80 and 40 metre bands was amazingly good for such a simple system. Of course, the stability of the receiver local oscillator will limit the convenience of using the BFO on an ordinary inexpensive transistor or valve type short wave receiver; already mentioned in Newcomers' Notebook some months back.

I don't think there is really any point in going into a lengthy description of the BFO as the notes supplied with it are quite comprehensive. Perhaps the most interesting feature of this BFO is the method used to vary the frequency. This is not accomplished with a variable capacitor as such. A potentiometer is placed in the circuit so that it varies the base voltage of the oscillator transistor. By varying this the junction capacities also vary, causing the frequency of the oscillator to alter, in this case plus or minus 5KHz at a centre frequency of 455KHz. A potentiometer is cheaper than a variable capacitor, and the tuning control can be placed remotely from the actual BFO for convenience. By feeding in audio to the base of this oscillator you would have an elementary FM oscillator on 455KHz. This is something that you could experiment with as an exciter for a VFO-controlled transmitter. Not necessarily on 455KHz either.

These inexpensive little kits are available from Bob Callander, VK3AQ, the YRCS Projects Officer. In this issue a technical article features this BFO. I believe that a variety of other small kits will be making their appearance from time to time, so watch "Amateur Radio" for further news.

Within a few months I expect to have an article on a variety of ancillary devices to go with your receiver, such as BFOs, and a variety of other things such as "S"-meters.

In a recent letter I was asked what an "S"-meter did, and why so named. I believe that its name may have come from a contraction of Signal Strength Meter. The "S"-meter as such is merely a meter to indicate relative differences in signal strength. Initially they were calibrated such that S1 equals 1uV, S2 equals 2uV, S3 equals 4uV, S4 equals 8uV, . . . S9 equals 256uV. You may commonly hear stations say that a certain station is, say 60db over 9. This is a signal input to the receiver of ¼ volt . . . and from a 10 watt station 1000 miles away ? The "S"-meter these days is commonly called a "guess meter", and perhaps this is a much more truthful name. Sets these days may be calibrated so that 50 or 100uV equals strength S9. The scales are not linear, and the over strength 9 figures are usually farcical. The sensitivity of sets varies from band to band, once again upsetting the calibration accuracy — if any. The value of an 'S'-meter is its ability to show a relative change in signal strength; it is not an absolutely accurate instrument. By adding a converter in front of your receiver you will once again make your 'S'-meter inaccurate, it will likely read higher than it should.

In conclusion it is a very handy meter to get relative signal strength readings, to use as a servicing aid in your set, and it is a worthwhile addition. ●

*44 Rathmullen Rd., Boronia, 3155, Vic.

NEW ADDRESS—W.I.A. EXECUTIVE:
P.O. BOX 150, TOORAK, VIC., 3142.

Magazine Index

With Syd Clark, VK3ASC

"73"—October
Frequency Synthesizer for 2 Metre FM Pt. 2; Solid State 6 Metre Crystal-Het-VFO; The FET Voltmeter as a Nano-ampere Meter; Time/Frequency Measuring System, Part 1; Active Filter Design and Use, Pt. IV; Transmission-Limit Timer for Repeaters; A ⅝ Wave-length Weather Balloon Vertical That Works; A Simple Inexpensive ID; Adjustable Time Delay Relay Circuit (Simple but effective VK3ASC circuit used 6 x 5 rectifier as delay element in bias supply circuit with pair of contacts used to ensure full heater voltage applied after delay operated); Power Lead Filters for 432; Portable House Power; Hot Carrier Diode Converter; RTL Decade and Driver; A Power-Supply Splitter for Linear ICs.

"BREAK-IN"—October.
The "Galbraith" R.F. Noise Bridge.

"BREAK-IN"—September
The "Climie" Transceiver; Keep It Cool Man; Stressed Paraboloid Antenna for 1296—2300 MHz.

"HAM RADIO"—SEPTEMBER
High-frequency Power Amplifier Pi Network Design; Quick and Easy Speaker Driver Module; Three-Band High-Frequency Log-Periodic Antennas; RTTY Distortion, Causes and Cures; Advanced Divide-by-Ten Frequency Scaler; Repeater Control with Simple Timers; Solid State Hang AGC Circuit for SSB and CW; Using Odd-ball Tubes in Linear Amplifier Service.

"HAM RADIO"—OCTOBER
Four-Channel Spectrum Analyser; High-Frequency Frequency Synthesizer; An Efficient All-Band Tuned Dipole; Five Frequency Crystal Deck for the Sonobaby; Pulse Snap Diode Impulse Generator; Adding 160 metres to a 40-Metre Vertical; New System for Predicting Six-Metre Sporadic-E Openings; Low SWR Dipole Pairs for 1.8 through 30 MHz; An Accurate RF Power Meter for Very Low Power Experiments. Two extremely good issues. Ham Radio takes a very workmanlike approach to the subject and is recommended as a valuable addition to anyone's library. ●

VHF UHF
an expanding world

With Eric Jamieson,* VK5LP

Closing date for copy: 30th of month.
Times: E.A.S.T.

VK0	52.160	VK0ZVS, Macquarie Island.*
	53.100	VK0MA, Mawson.
	53,200	VK0GR, Casey.
VK2	52.450	VK2WI, Dural.
VK3	144.700	VK3RTG, Vermont.*
	144.925	VK3QZ, Traralgon.
VK4	52.400	VK4WI/2, Townsville.
	144.390	VK4WI/R1, Toowoomba.
VK5	53.000	VK5VF, Mt. Lofty.
	144.800	VK5VF, Mt. Lofty.
VK6	52.006	VK6VF, Bickley.
	52.900	VK6TS, Carnarvon.
	52.950	VK6VE, Mt. Barker.
	144.500	VK6VE, Albany.
	145.000	VK6VF, Bickley.
VK7	144.900	VK7VF, Devonport.
VK8	52.200	VK8VF, Darwin.
ZL1	145.100	ZL1VHF, Auckland.
ZL2	145,200	ZL2VHF, Wellington.
	145.250	ZL2VHP, Palmerston North.
	431.850	ZL2UHF, Palmerston North.*
ZL3	145.300	ZL3VHF, Christchurch.
ZL4	145.400	ZL4VHF, Dunedin.
JA	52.500	JA1IGY, Japan.
HL	50.100	HL9WI, South Korea.

*Denotes change.

The VK3 beacon appears to have changed already to the new allotted PMG callsign of VK3RTG. The VK6 beacons near Perth will assume callsigns in the future of VK6RTV. VK0ZVS is re-included in the list as it has not only been heard but worked (see paragraph further on). JA4IGY, JA5IGY, JA8IGY, JA8IGY and JA9IGY are all to be found on 50.500.

SIX METRES

Big things have been happening on six metres during the past month, so much so that it seems a pity these notes are prepared so far ahead (12/12/72) for the February issue. But the deadlines must be met! However, VK0 has certainly been in the news during the past few days. Believed to have been first heard and worked in VK2 on Sunday, 10th December, but it took Monday 11th to really get things going, particularly on the VK5 scene, where I am in close touch. VK0ZVS and VK0WW were both worked by Wally VK5ZWW and Barry VK5ZMW on 52.160 around 1830 hours with signals peaking to 5 x 7. VK2 and VK3 stations were heard calling them at the same time so it is presumed they also worked these two stations. At 2137 Bob VK5ZDX heard the beacon station VK0GR at Casey about S4 using AFSK ident. but did not work him.

So all this means a new call area added to the Australian scene of six metre workings. The distance would be about 3000 miles to Macquarie Island and represents probably triple hop Es. Congratulations to all those who have so far been successful in working the cold South regions, and as the d.x. season progresses into 1973, perhaps many more will have their first VK0 QSO. Between 1800 and 2100 on 11th December just for the asking, in VK5 anyway, you could work VK2, 3, 6 or 7, with VK2 and VK3 mainly on backscatter. To add to the fun, Wally VK5ZWW and Bob VK5ZDX were having one of their usual hour-long natters on the band after the VK0 opening when ZM3AAN broke in, so conditions were still very wide open.

The good conditions continued again on Tuesday 12th, with VK1, 2, 3, 4 and 6 being worked. Extremely strong signals were available from VK3, indicating a rising MUF. VK2 were heard working to VK6, which is also a long path.

432 MHz RECORD

While all the good 6 metre d.x. was taking place there were those paying attention to other bands as well. The Channel 4 repeater from Adelaide was heard in Albany, W.A. Mick VK5ZDR and Tony VK5ZDY worked Wally VK6WG on 2 metres, with signals at 5 x 9 on the 11th, and then capped it all by working him on 432 MHz with signals 5 x 7. The distance to Tony would probably be the longest by several miles, somewhere around 1200 miles, which would be an Australian record, unless someone else has done something more spectacular while I write these notes!! Good work, chaps, all credit to you.

So now I can get out my trumpet and proclaim that months ago I had a feeling things would come to v.h.f. between now and 1975 and this surely is the beginning. With the greater use of SSB and its inherent advantages we will surely see some long-distance work being done on 144 and 432 MHz, with perhaps the peak years being 1973 and 1974. There is certainly something to be said for transceiving, knowing exactly where the other chap is, and keeping the frequency clear of other stations whilst making the contact. Anyway, December, 1972, will go down in v.h.f. history as being a great month.

NEWS FROM DARWIN

While all the d.x. has been going on Doug. VK8KK has been noted loafing around Adelaide on leave. Cornered in the shack of Bob VK5ZDX he did tell me that the Darwin gang has now completed its new all solid state 6 metre beacon, which uses a digital keyer. The previous beacon was heard in many places overseas, particularly KH6, so the new beacon with its improvements may be heard even further.

Doug. also mentioned having quite a lot of success with Oscar 6, having heard all ZL districts, and heard JA's. He also received SSTV, video from John VK7JV, quite good pictures, in fact, but was unable to complete a contact due to running out of time to leave for South Australia. Doug. anticipates big things for Oscar during the coming year when the first flush of excitement has died down, and people get down to serious work through the satellite. So far his workings through Oscar 6 have been to VK1, 2, 3 and 7, the 5's so far eluding him!

AMATEUR TELEVISION

A letter from Winston VK7EM outlines plans for ATV tests during January, February and March, 1973. Unfortunately the letter arrived too late for inclusion in January "A.R.", but Winston advises he will be running tests on 432 MHz a.m. and t.v. every evening when conditions are favourable, and the VK3 beacon is audible. He will transmit a.t.v. video at 2000 hours Eastern Summer Time for 15 minutes, and listen for reports at 2015 on 432 MHz and 2020 on 144 MHz a.m., s.s.b. and c.w. The transmitting frequency is 432.28, if QRM is noted he will change to 426 MHz. He will also look for other stations transmitting a.t.v. Winston would be pleased to have reports from anyone, and his work has distinct possibilities for both VK3 and VK5.

A letter from Mike VK2AM advises of several brief JA openings into the Sydney area during November, and remarks on the ever-increasing use of 52.010 MHz as an s.s.b. calling and monitoring frequency. He voices the opinion that he would like to see the first 10 kHz of the band kept for c.w. dx. Have you any thoughts? Mike also reports that Roger Harrison VK9RI on Cocos Is. has been hearing VK8VF for hours, also the VK6 beacons and VK5VF once. Roger will be running automatic transmissions with voice indent. with a periodic break. He will monitor the beacon for any callers, and will be using his callsign VK9RI.

FIELD DAY OPERATIONS

The VK5 v.h.f. Field Day on 3rd December went off well, with seven stations out in the field. After setting up their various stations the field day operators were treated to a big 6 metre dx opening, with signals being available from VK1, 2, 4, 5, 6, 7, and ZL1, 2 and 3, although no ZL signals were available during the hours the Field Day operated!! Two metres was disappointing; best contacts being to Kerry VK5SU at Ceduna and only as far as Mildura in VK3. So there is something to be said for having a Field Day around the start of the dx season, and run in conjunction with one in ZL adds to the interest.

That seems to be about the end of the news for this time. Not much use repeating a lot of the 6 metre dx scene, as all those likely to read these notes seriously will already be on 6 metres and hear the news first hand and much earlier than this. So at this point we will close with the thought for the month: "Since teenagers are too old to do the things adults do, they do things nobody else does."

The Voice in the Hills

CONTESTS

With Peter Brown,* VK4PJ

Bowls, fishing, cricket, radio . . . .

One often hears remarks to the effect that contests are of little value. Perhaps a large proportion of entrants participate because of a sense of loyalty, because they realise the value of contests to their hobby and would not like to see contests, competition if you wish, disappear.

The fate of those who do not have to try is known to most of us. A radio contest requires one to put forward his best efforts with equipment in top condition and operating ability at a high level, be it for two or 24 hours.

We must accept that there are fellow contestants with better or more powerful equipment, but make sure that they are kept to a high standard by your operating ability.

Operating ability includes a knowledge of conditions, paths, modes, &c., apart from speed and quality in voice and hand.

If you are not a designer or builder of new or advanced radio equipment or are not working directly for the WIA, you can help your hobby a great deal by trying hard and setting a high standard for the time that you can afford in any contest. If we can develop some of the world's best swimmers and yachtsmen surely we can do the same in radio.

Compete, try hard to set a high standard.

JOHN MOYLE MEMORIAL FIELD DAY CONTEST (December "A.R.")

You have probably realised that Rule 13 should have read . . . "Entrants must call "Mobile" or "Portable" as the case may be, e.g. "VK3XY mobile" if a mobile station, or "VK3XY portable" if a fixed field station.

Also in the SWL log example VK3ATL should be VK3ATL/P. I must have loked at the 1972 calendar when I showed on page 7 the National Field Day as 12th and 13th whereas it should have been 10th and 11th. The second weekend of February. If you have not planned for the Field Day (rules page 17, Dec. "A.R.") it is surprising what can be done in a few days.

* Federal Contest Manager, Box 638, G.P.O., Brisbane, Qld., 4001.

PREDICTION CHARTS

The prediction charts were discontinued because of the high costs of block making. Now the charts are received as computer print-outs. For many months numeric predictions have been printed as a substitute on the basis that half a loaf of bread is better than no loaf. The interest in predictions however appears to be negligible and consideration is being given to omitting them altogether. What do you think?

W.A. RAFFLE

A Special "AR" Report

Like most societies, the W.A. Division of the W.I.A. is short of money. This point was high-lighted dramatically when, in 1971, the subcriptions were raised to $12.50 per annum. With only about 300 members scattered over a large area, services such as the weekly broadcast, the local Bulletin and the provision of club rooms for visiting country members were considered essential by many. Unfortunately, even with a $12.50 subscription, there was only sufficient money to cover the Bulletin costs, "A.R.", Federal dues and the like. Nothing remained for replacement of broadcasting equipment, provision of repeaters, and so on. With these problems in mind, the W.A. Council debated the question of how to raise money from inside and outside the Division. They agreed that perhaps a raffle would provide sufficient money to get some of these projects off the ground.

Having decided to go ahead with a raffle, a sub-committee was formed, comprising VK6HD, VK6NE, VK6EU and VK6PG. These four people quickly realised that they may have caught the proverbial tiger by its tail. Many hours were spent in deciding the number of tickets to be sold, the price of the tickets and the value of the prizes. In this regard much help was given by the W.A. Lotteries Commission.

It was finally agreed that approx. $900 would be spent on prizes to make the raffle attractive to non-amateurs as well as to amateurs, and that 25,000 tickets would be printed for sale at 20 cents each. It was also estimated that printing and postage costs would absorb another $350. All this sounded fine until one committee member pointed out that to sell this number of tickets, every 40th person in this State would have to be in the draw!

Initially one book of raffle tickets was sent to every W.A. member, together with a covering letter and an S.A.S.E. This was followed by writing (with books) to all known amateur clubs in Australia offering them 10 per cent. of ticket sales for their club funds. Finally books were sent to every newly licensed VK6 amateur and to every licensed amateur in Australia known personally by the members of the raffle committee.

After an initial influx of money during the first two or three weeks returns of sold books eased off alarmingly.

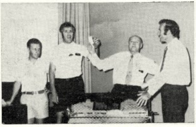
Four weeks before the draw date, thanks to pushing and prodding by numerous W.A. members, expenses were covered, and from that day on sold books and money just seemed to come rolling in. Daily sessions were then held to deal with requests for more books, to bank the cheques and to deal with the numerous associated problems.

At draw date, 19th December, over 14,000 tickets had been sold and it looked as if this Division would emerge with a profit of around $1700.

We were fortunate in having the Superintendent, Radio Branch, Mr. E. Trigwell, to draw the winning tickets, under the eagle eyes of over 100 members and their friends. The lucky prize winners are:—

PRIZE	WINNER	Ticket No.
FIRST:	M. Sharp, MAYLANDS, W.A.	16,130
SECOND:	P. Halden, LESMURDIE, W.A.	251
THIRD:	I. B. Williamson, EAST DONCASTER, VIC.	11,022
FOURTH:	W. Buck, JOONDANNA, W.A.	4870
FIFTH:	P. Alliss, HOLLYWOOD, W.A.	15,126
SIXTH:	J. Sweet, AITKENVALE, QLD.	6944
SEVENTH:	R. G. B. Vaughan, MORLEY, W.A.	14,738
EIGHTH:	Thomas W. Fehr, WOOMERA, S.A.	20,126
NINTH:	Vicki Male, GOSNELLS, W.A.	4650
TENTH:	F. G. Bail, BOX HILL NORTH, VIC.	2194

Obviously this satisfactory result could not have been achieved without the help of many, many people. We are grateful for the support given to us by amateurs in other Divisions and also thanks are due to our own members. Without this help the raffle project could have been doomed to failure. We now have a little money in the bank. ●



Drawing the first prize ticket. L. to R.: Peter Dew, VK6EU (Treasurer), Mike Bazley, VK6HD (President), Mr. E. Trigwell, Neil Penfold, VK6NE (Sec. and Fed. Councillor).

NEW YEAR BROADCAST

A Special "AR" Report

For those who may have missed it, here are extracts from the Federal President's end of 1972 recorded seasonal greetings address for transmission over Divisional broadcasts.

"From the Federal aspect undoubtedly significant is the fact that for the last 10 months the Institute's publication Amateur Radio has been conducted by the Federal body.

Your magazine has been under the control of an active and enthusiastic Publications Committee. They have tried valiantly to improve the magazine and I believe they have succeeded. But may be you think that there are other changes that could still further improve it.

I can assure you that the Publications Committee welcomes comment. If you have any suggestions please let the Publications Committee know your views.

Unfortunately, as in a number of areas involving finance, we are facing a bleak year in 1973 so far as the magazine is concerned. Costs have continued to rise. The money budgetted for next year for the magazine will almost certainly be inadequate.

We do not want to reduce it to 16 pages on newsprint. We hope we won't have to.

If the cost to the Divisions is increased then either the Division must take less for its own needs from each member's subscription or it must increase its subscriptions.

Our magazine is very dependent on advertising. Please, have a look at some recent copies of Amateur Radio. Note where the advertising comes from.

Are you surprised how little comes from your State? This is an area where there are many who can help. Can you bring in some advertising? If you can, you may not only enable your Division to avoid in the future fee increases, you will also enable us to improve, even further, your magazine.

Undoubtedly, one of the most important decisions of the Federal Convention this year was the decision to seek a new licensing structure, including a Novice Licence. Almost all the response to these proposals have been favourable. These changes will involve important administrative changes on the part of the Australian Post Office. I believe there are valid and compelling reasons why the Institute's submissions should be accepted. I am hopeful they will be accepted.

One pleasing feature of the last year has been the debate within the Institute on matters directly concerning our hobby. Matters such as repeaters.

To my mind these discussions are constructive and they are the sort of thing that the Institute is all about.

We must however guard against our own strongly held convictions leading us to disregard the framework within which these matters must be resolved.

We cannot hope for everyone to agree.

Our decisions are useless unless they are effective. Our decisions cannot be effective other than within the framework of our organisation.

As 1972 draws to a close I believe we can look back on a year that has been both interesting and constructive. Given a national body that has the continued support of the Divisions and of the membership I believe we can look forward to 1973 with some confidence." ●

"20 YEARS AGO"

With Ron Fisher, VK3OM

Feb., 1953.

Let us look at a copy of Amateur Radio dated February, 1953, so that we can see what it looks like in the physical sense. There were 16 pages of content printed on newsprint paper. The cover page was printed on a grade of paper similar to our present Amateur Radio and carried a price of one shilling. The cover advertisement will be remembered by many old timers—a Philips valve, with the caption, "It's the valve that makes the music". Out of 16 pages five were devoted to Federal, QSL and Divisional notes, five to technical articles, one each to dx notes, vhf notes (50 megacycles and above), contents and callsigns, a dx countries list plus, of course, the editorial page.

Well, so much for the general appearance of the magazine; now let us look at the contents in detail.

One of the more practical services of the Institute in those days was accurate frequency transmissions from Divisional stations. Feb. A.R. listed the transmissions that would take place from VK3WI over the next few months. Commencing at the edge of either the 40-metre or 80-metre band, transmissions would then be made every 20 kHz throughout the band. The frequency of each point was then checked with the PMG frequency measuring centre and corrections then broadcast. Very handy to calibrate a new receiver or VFO. In those days most of our gear was home built. Leading the technical articles for February, 1953, was "A Beginner's Approach to the Calculation of Inductance", by T. D. Athey. This was an extract of a lecture at the Queensland Division of the WIA's AOCP classes. Mr. Athey showed how to put theory into the practice of coil winding.

The concluding part of N. Southwell VK2ZF's article "A Phasing Type Single Sideband Suppressed Carrier Exciter" discussed the adjustment and tuning procedure. In all a most informative series and certainly worth looking at if you are contemplating the construction of a phasing-type transmitter.

Federal notes include news of the release of the 21 MHz band in South Africa, Finland and also Great Britain. Also that the Hawaiian Islands would soon become the 49th State of the U.S.A. Federal Executive posed the question as to whether KH6 would retain its separate country status. ●

INTRUDER WATCH

With Alf Chandler,* VK3LC

With the co-operation of some dedicated VK4 members I am now receiving regular read-outs of RTTY Intruders and have identified the following — TCX, Turkey, 14152 kHz; HMB22, HMD7, Korea, 14296 kHz; KJG, Korea or Vietnam, 14284 kHz.

There are still many more unidentified Intruders, and once again I urge Amateurs with RTTY facilities to join those members in taking read-outs of anything that they can copy, send it to their Divisional Co-ordinator, or to me direct.

Many A1 CW Intruders are being idtentified by callsign, too, and this is very good because by so doing I can expect full co-operation from the Radio Branch, and liaison at the moment is excellent.

It is very noticeable that when a CW contest is in operation Intruders disappear, particularly RTTY. The moral to be deduced from this fact is the necessity of populating our bands to the full extent.

A very sincere welcome is extended to our new VK5 Co-ordinator, Leith VK5LG, whom I am hoping will exercise his prerogative as do our other co-ordinators. It is regretted though that VK6 and VK7 are not represented by co-ordinators. How about it? ●

*Fed. I.W. Co-ordinator, 1536 High St., Glen Iris, Vic., 3146.

Are you organised for the National Field Day?

The National Field Day is February 12th and 13th

Commercial Kinks

With Ron Fisher,* VK3OM

Over the last month or so Melbourne weather has been more conducive to swimming, sailing and watering of gardens than writing Commercial Kinks. I am therefore presenting a slightly smaller edition than usual. However, I hope no less interesting.

Heathkit Single-band Transceivers.

The greatest drawback of these units is of course just this—they only cover one band, probably the wrong one. Some years ago a commercial kit (not Heathkit) was put on the market to tri-band any of the three models. I am not sure if these are still available or not. To try and duplicate this tri-banding procedure at home is quite a job, which has nevertheless been succesfully tackled by a few. Commercial Kinks is taking the easy way out. Bill VK2BWF solved the problem by changing bands permanently. Here is his account of how to do it . . .

Heath Kit HW12 80-metre Transceiver Conversion to 40 Metres.—The HW12 is a single band (3.8-4.0 MHz) transceiver and is one of the series of three units, HW12 (80 metres), HW22 (40 metres) and HW32 (20 metres) designed principally for mobile operation. All three units use a common printed circuit board and similar circuitry, the principal difference between the units being that the 80-metre unit employs V14 6BE6 as a V.F.O. cathode follower, whereas in the 40 and 20 metre units V14 6BE6 is employed as a V.F.O. heterodyne mixer. **Fig. 1** shows the frequency generation scheme of the HW12 and HW22.

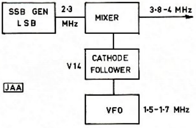


FIG 1a HW12-80 METER, ADDITIVE MIXING, SIDEBAND UNCHANGED

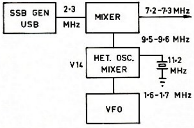


FIG 1b HW 22-40 METER, SUBTRACTIVE MIXING, SIDEBAND REVERSED

To convert the HW12 to HW22 it is necessary to obtain the heterodyne oscillator crystal (approx. 11.2 MHz), obtain USB carrier crystal and remove LSB crystal. Obtain or make a V.F.O. heterodyne transformer L5, replace or rewind the driver grid coil L2, driver plate transformer L3 and the TX output coil L4. The π output fixed loading capacitor C77 must also be changed from 1300 pf to 680 pf. The circuitry of the heterodyne oscillator mixer V14 must be rewired from the cathode follower circuit to the heterodyne oscillator circuit. As mentioned above the printed circuit board has all the necessary holes for this conversion.

In the case of my conversion it was decided to retain the original SSB generation arrangement—i.e., retain the original carrier crystal (LSB). This means that subsequent mixing of the SSB to 40 metres must be additive rather than subtractive as in the authentic HW22. The final arrangement is shown in **Fig. 2**.

*3 Fairview Ave., Glen Waverley, Vic., 3150.

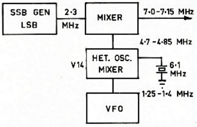


FIG 2 FINAL ARRANGEMENT

The heterodyne oscillator crystal was a disposals 5995 kHz ground up to 6.1 MHz. The V.F.O. was padded down to the frequencies shown by means of a fixed 47pf NPO disc ceramic and results in a 150 kHz frequency coverage.

Improving the Eddystone 888A for SSB.

In common with many other receivers of the late 1950s and early 1960s the 888A incorporated a product detector which in terms of resolving SSB just did not work. However a few simple modifications will make a vast improvement. The main problem is too much r.f. input to the product detector. The input coupling capacitor C72, 500 pf should be reduced to 10 pf. C72 is located towards the back of the chassis near V6 (6AT6) and connects to a coaxial lead feeding to the product detector. With this change even quite strong signals can be handled with both the r.f. and i.f. gain controls full up. Even the "60 db over 9" type signals can be brought into line with a touch of the i.f. gain.

Now the AGC has a chance to work and a small change here will help, too. R39 0.47 megohm should be increased in value to 2 megohms. This increases the decay time to a better value for SSB reception. The AGC connection to the first mixer should be disconnected inside the coil box—just tape up the end of the lead (brown plastic in my set) and leave it so that it can be reconnected later if need be. The reason for disconnecting the AGC is to reduce the frequency pulling of the first oscillator.

These small changes will give the 888A a new lease of life on SSB and also CW without affecting performance on AM for the 160 Mx men. ●

Letters to the Editor

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the Publishers.

44 Rathmullen Road,
Boronia, 3155. Vic.

Dear Sir,

I am establishing a private museum of old ex-army portable transceivers. The ones I am interested in are of immediately pre-World War II, World War II and immediately postwar. It is common knowledge that a large number of the sets I am interested in came on to the disposals market after the war.

The particular sets I am interested in include the No. 122, No. 22, No. 11, No. 19, No. 108. No. 109. FS6, 3BZ (tx and rx) and probably the Type A Mk. 3 and the Type 3 as well. I would like to obtain at least one of each of these sets, as well as service and/or operator handbooks. Probably the hardest information to obtain would be on the history of each type of set, its design philosophy, when and where used, and the opinions of the people who used and serviced the sets.

If I can obtain the information and sets listed in the above paragraph I can, I hope, assemble a worthwhile, comprehensive working museum of part of our history, and a tribute to the designers of these pieces of equipment. It is likely that some of the readers or their friends may have some of these pieces of gear, either complete or portions of same, lying about unused and possibly unmodified, or very little so. Can you help me to preserve this part of our history. I am willing to pay reasonable prices for equipment and transportation costs. Once completed the museum could be viewed by those interested by arrangement. My telephone number is 231-2028.

Yours faithfully,
Rodney Champness VK3UG

NEW ADDRESS—W.I.A. EXECUTIVE:
P.O. BOX 150, TOORAK
VIC., 3142

NEW CALL SIGNS

SEPTEMBER, 1972

A.C.T.
VK1AF—H. W. Heck, 17 Embley Street, Holder, 2611.
VK1BJ/T—B. J. Dwyer, c/- Hotel Acton, Canberra, 2601.
VK1ZSE—S. J. Edwards, 86 Vasey Crescent, Campbell, 2601.

N.S.W.
VK2CA—R. M. Hartnett, 40 Hermitage Road, West Ryde, 2114.
VK2I0—W. A. A. Brown, 3 Bedford Place, Brighton Le Sands, 2216.
VK2WI/R—W. I. Australia, 14 Atcheson Street, Crows Nest, 2065.
VK2AIG—I. E. Bain, 33 Bondi Road, Bondi Junction, 2026.
VK2AOA/R—Orange and District Amat. Radio Society, Station 255, Peistley Street, Orange Postal P.O. Box 802, Orange, 2800.
VK2ARA—E. C. Thrift, 5 Spencer Avenue, Armidale, 2350.
VK2BHS—H. J. Smit, 9 Moore Court, Faulconbridge, 2776.
VK2BKK, C. M. Colston (Jun.), 1/48-50 Edith Avenue, Leichhardt, 2044.
VK2BQK—M. J. Bredimus, 9 Johnston Crescent, Lane Cove, 2066.
VK2ZLZ—J. C. Mounsey, Station Add., 6/21 Park Avenue, Randwick, 2031. Postal, c/- Commonwealth Bank, Bondi Junction, 2022.
VK2ZTS—L. T. Scotney, 8 Sylvan Grove, Picnic Point, 2213.

Vic.
VK3DC—D. M. Clancy, "Imdkalee", Main Road, Sassafras, 3787.
VK3UK—V. E. Marshall, 33 Rendlesham Avenue, Mt. Eliza, 3930.
VK3VE—The Wireless Institute of Victoria, Rooks Road, Vermont, 3133.
VK3YG—R. G. Davey, 23 Greenwood Street, Greensborough, 3088.
VK3AEU—C. J. Schultz, corner Clarke and Grant Streets, South Melbourne, 3205.
VK3BGP—R. D. Blackshaw, 13 David Street, Glenroy, 3046.
VK3RAG—Geelong Amateur Radio Translator Group, "Bayview", Haines Road, Gnarwarre.
VK3YHD—A. Langer, 50 Windsor Avenue, Mount Waverley, 3149.
VK3YHE—W. S. Ely, 29 Field Street, Shepparton, 3630.
VK3YHP—H. J. Payne, 2/3 Pye Street, Swan Hill, 3585.
VK3ZBE—G. J. Butler, 26 Lorimer Street, Melton, 3337.
VK3ZBN—L. M. Cole, 10 Medway Street, Footscray, 3011.
VK3ZMB—N. W. G. Barker, 19 Lindsay Street, Middle Brighton, 3186.
VK3ZSS—D. J. Smith, 5 Rushall Street, Fairfield, 3078.
VK3ZUH—Educational Reform Association, E.R.A. School, Springvale Road, Donvale, 3111.
VK3ZZD—D. K. Morgan, 2 Huxley Court, Bayswater, 3153.

QLD.
VK4AM—H. C. Barlow, 42 Cook Street, North Ward, Townsville, 4810.
VK4EE—D. R. McLean, 62 Malakoff Street, Biloela, 4715.
VK4EG—G. N. Vayro, R.A.A.F. Base, Garbutt, 4814.
VK4FB—I. C. Fisher, 63 Collins Street, Woody Point, 4019.
VK4MK—M. T. K. Power, 35 Freda Street, Mt. Gravatt, 4122.
VK4ZV—R. L. Chadwick, Station Flat 2, Coronation Hotel/Motel, Brisbane Road, Ipswich, 4305. Postal, c/- U.S.A.F. Det. 436, R.A.A.F., Amberley, 4305.
VKZEZ/T—E. J. Roache, Flat 5/6 Riverview Terrace, Hamilton, 4007.

S.A.
VK5LS—E. L. Smith, 9 Feltus Street, Pt. Lincoln, 5606.
VK5VE—W. N. Thomas, 64 Eliza Street, Salisbury, 5108.
VK5ZRZ—W. S. Baynes, 29 Strathspey Avenue, Hazelwood Park, 5066.

W.A.
VK6CZ—C. F. Lloyd, 351 Egan Street, Kalgoorlie, 6430.
VK6SX—W. M. C. Quinlan, 175 Daglish Street, Wembley, 6014.
VK6UU—W. R. McGhie, 39 Edgewater Road, St. Lucia, 6152.
VK6VP—V. P. A. Magry, 1 Susan Street, South Perth, 6151.
VK6WH—W.A. VHF Group, Postal, 10 Hickey Street, Applecross, 6153. Station, Wireless Hill, Museum.
VK6ZBP—P. R. Beck, 41 Kurrajong Place, Greenwood Forest.
VK6ZEF—R. J. Wynn, 58 Clayton Street, Fremantle, 6160.

Tasmania
VK7US—R. A. Els, 20 Jillian Street, Launceston, 7250.
VK7NR—A. N. Richardson, 69 Georgetown Road, Newnham, 7250.
VK7ZRD—R. L. Davis, 29 Brimsmead Road, Mt. Nelson, 707.

N.T.
VK8OU—P. C. Kozup, Flat 24, Smith Street, Darwin, 5790.

Territories
VK9AP—K. C. Parker, P.O. Box 586, Madang.
VK9BP—R. Pearson, Postal, P.O. Box 5787, Boroko. Station, Section 37, Lot 6, Mavaru Street, Boroko.
VK9DG—D. W. Guthrie, Postal, P.O. Box 301, Rabaul. Station, Tunnell Hill Road, Rabaul.
VK9FD—F. Dowse, Postal, P.O. Box 301, Rabaul. Station, Lot 26 Section 58, Rabaul.
VK9FV—B. A. Stevens, Postal and Station EMQ, 144 Murray Barracks, Boroko.
VK9GO—R. S. Goldsworthy, P.O. Box 26, Panguna, Bougainville, N.G.
VK9IF—I. Fletcher, Manus High School, Lorengau.

Antarctica
VK0IN—K. V. Hanson, Mawson.
VK0JO—J. P. O'Shea, Davis.
VK0WW—R. W. Worden, Macquarie Island.

Y.R.S.

With Bob Guthberlet*

For many years I have been a firm believer that youth clubs are the answer to youth boredom, and in anticipation that shorter working hours will come to Australia in the near future it will mean more time, either for creative activity, or to pursue the fruits of boredom—the wastage of talents and the increase of delinquency. Westlakes Radio Club in N.S.W. has the slogan "Progress Through Activity" is one which we all could think about.

To promote knowledge and worthwhile use of leisure time is fundamental to the youth of Australia. Unfortunately, in the sphere of electronics, industry as a whole has not grasped the opportunities which face it. Youth radio is a tremendous sales potential, and manufacturers of components and equipment would reap great benefits if they awakened to this market for their products. Some form of liaison between industry and youth radio clubs would be worthwhile.

Youth radio is not asking for hand-outs from industry but, rather, for interest and an awareness of what we are doing . . . to encourage us in what we are doing and to recognise those who are giving their time and talents to foster a creative activity for young persons.

If Australian concerns are not interested in youth potential, be assured that others Overseas are not blind to the possibilities of an ever-increasing market for their products.

The understanding that Y.R.C.S. is an integral part of the W.I.A. prompts me to point out once again that every father has an obligation to foster the welfare of his offspring, and that the amateur fraternity, being the parents of youth radio in Australia, can and should accept some responsibility by offering their expert knowledge and giving practical assistance to a movement which rightfully expects some paternal expression of interest and support.

As an amateur you have been helped at some time to achieve the status you now have. Please help us to help the youth of Australia. ●

*Federal Y.R.C.S. Co-ordinator, Methodist House, Kadina, S.A., 5554.

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It is easy to remove a mailing plate, but harder to restore it. Moreover you might miss some issues.

Make every contest a success by joining in.

VARACTOR TUNED BFO

(Continued from Page 10.)

Inductance mH.	N Turns	Q
L1 = 16	184	Using one only wire size for all coils (that for largest L), L2 will have worst space-factor and Q, but this is still acceptable at 140.
L2 = 2.75	76	
L3 = 25.2	232	
L4 = 8.5	134	
L5 = 12.1	160	

TABLE 4.
5th Order Elliptic Filter

(3) $\frac{R_D}{L} = [(2 \div 200) + 0.01]\ 5^3 \times 10^9 \times 2.5 \times 10^{-3} \times 52.1 \times 10^{-10}$

(Assume the hoped-for-Q at this stage, and check later.)

$= 0.033$ ohms/henry (negligible)

(4) $\frac{R_H}{L} = 800 \times 180 \times \frac{2.5}{1{,}000 \quad 70} \times 1 \times 10^{-3} \times 5 \times 10^3$

(Assume a standard 1 mA. current at this stage)

$= 72 \times 0.357 = 26$ ohms/henry.

(5) $\frac{R_{ER}}{L} = [(1.5 \times 10^{-6}) - (3 \times 10^{-12} \times 5 \times 10^3)] \times 6.28 \times 180 \times 5 \times 10^3$

$= 8.5$ ohms/henry.

$$\frac{R_{TOTAL}}{L} = 88 + 26 + 9 = 123$$

$$Q = \frac{6.28 \times 5{,}000}{123} = 250$$

Error in Q is quite significant at 5 kHz. (about 40% high) if only the first loss calculation is made. ●

Ionospheric Predictions

With Bruce Bathols,* VK3ASE — FEB., 73

Listed below are the Ionospheric Predictions for February, 1973, from information supplied by the Ionospheric Prediction Service Division.

These listings should provide communication between the times stated for most days of the month.

The 28 MHz band does not appear to provide much value from the charts. However, there are many spasmodic openings predicted particularly around noon local time, and at sunset. It may pay 10-metre users to tune the band around these times.

All times are G.M.T.

28 MHz.—

VK1/2	to	KH6		0200-0500
VK4	"	W6		2300-0200
"	"	JA		2300-1000

21 MHz.—

VK1/2	to	SU		0400-1100
"	"	KH6		2000-1100
"	"	ZS		0600-1100
"	"	G	S.P.	0700-1100
"	"	G	L.P.	0900-1000
VK3	"	VE3	S.P.	2000-0100
"	"	UA		0400-1100
"	"	W1		2000-0100
"	"	PY		0100-0400, 1000
VK4	"	W6		2000-0300
"	"	JA		2200-1500
"	"	5Z	S.P.	0700-1100, 2300-0300
"	"	5Z	L.P.	0800-1500, 2000-0300
VK5	"	G	S.P.	0700-1100
"	"	G	L.P.	1000
"	"	ZL		2100-1100
"	"	ZS		0500-1100
"	"	W6		2300-0300
VK6	"	W1		2300-2400
"	"	PY		0900-1200
"	"	5Z	S.P.	0100-0200, 0600-1300
"	"	5Z	L.P.	2300-0400, 0800-1100
VK7	"	PY		2400-0400
"	"	JA		2200-1000
VK8	"	VKO		0700-0900
"	"	ZS		0500-1300

14 MHz.—

VK1/2	to	SU		1000-0100
"	"	KH6		0400-1400, 1800-2100
"	"	ZS		0500-0600, 1200-1600
"	"	G	S.P.	0700-1900
"	"	G	L.P.	0800-1300, 2100-2300
"	"	VK0		2000-1300
VK3	"	VE3	S.P.	1300-2000
"	"	VE3	L.P.	1400-1600, 2100-0100
"	"	UA		0700-1600
"	"	W1		1300-1900
"	"	PY		2000-1300
VK4	"	W6		0400-0900, 1600-2000
"	"	JA		0300-1800, 2100-2300
"	"	5Z	S.P.	1400-2400
"	"	5Z	L.P.	0400-0500, 0800-1200 1500-2000
VK5	"	G	S.P.	0800-1900
"	"	G	L.P.	0800-1400, 2200-2300
"	"	ZL		2400-2400
"	"	ZS		1200-1600
"	"	W6		0400-0900, 1600-2100
VK6	"	W1		1400-2400
"	"	PY		2300-0400, 0500-1200
"	"	5Z	S.P.	2300-0300, 1400-1900
"	"	5Z	L.P.	0700-1100, 1500-1900
VK7	"	PY		1900-1300
"	"	JA		0500-1800, 2100-2300
VK8	"	VK0		2100-1500
"	"	ZS		1200-2300

7 MHz.—

VK1/2	to	ZL		2400-2400
"	"	SU		1500-2100
"	"	KH6		0800-1700
"	"	ZS		1600-2000
VK3	"	G	S.P.	1500-2100
"	"	G	L.P.	0800
"	"	VK0		2400-2400
"	"	VE3	S.P.	0800-1300
"	"	VE3	L.P.	2100
VK4	"	W6		0700-1600
"	"	PY		0800
VK5	"	UA		1300-2100
"	"	W1		0800-1300
VK6	"	JA		1000-2100
"	"	SU		1400-2100
VK7	"	ZS		1600-2000
"	"	W6		0800-1500
"	"	ZS		1200-1600

*3 Connewarra Avenue, Aspendale, Vic., 3195.

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- Signed copy, in typescript preferred.
- Exceptions by PRIOR arrangement only.

For full details, see January, 1972, A.R., Page 23.

FOR SALE

Ashbury, N.S.W.: Two AWA TV Monitors, 21" and 19", ex-deceased's estate. Write 12 First St., Ashbury, N.S.W., 2193.

Adelaide, S.A.: Lafayette HA800 Solid State Receiver, 80 to 6 m.x. bands only, double conversion, ceramic filter, in brand new condition, in original carton; $150. Phone (082) 71-3716, or Sydney (02) 929-0674 (bus.). Keith Gooley.

Dandenong, Vic.: Cossor 1049 Double Beam CRO, plus spare set valves; $50, O.N.O. University MVA-6, VTVM, with 250 MHz, r.f. probe, perfect condition, $40. VK3ZZG, Ph. (03) 795-2506, or QTHR

Boronia, Vic.: Computer, core memory, 65K bits in Four 16, 384 bit planes; ex IBM 7090 machine, ex Meshna, U.S.A. Sold as is, all address lines O.K., but some sense lines need reterminating. With IBM memory handbook. Approx. 1.5 microseconds read time. At cost, $70. E. T. Schoell, Box 30, Boronia, Vic., 3155. Ph. (03) 762-3308.

Alphington, Vic.: Signal Generator, sine and square wave. Calibrated 10Hz to 500kHz. Output 20 volts P.P. Valve type, with self-contained 240 v. A.C. power supply; $12. 49-6524. VK3AOH, QTHR.

Woomera, S.A.: Eddystone EC10 Mk. II., a good general coverage Receiver; $170. Bug Key, little used; $12. Mono. Cassette Deck, 6 v.; $10. VK5NQ Box 38, Woomera, S.A., 5720.

Ashfield, N.S.W.: Galaxy 5 Mark 2 Transceiver, good condition, complete with p.s. VK2AXJ. QTHR. Ph. (02) 798-9021.

Sydney, N.S.W.: SSB Transmitter, 150 w.; $50. Double Conversion Receiver; $50. 19" Rack Cabinets; $5. Command Receivers, LF; $10; HF, $5 VK2AAB. QTHR. Ph. (02) 487-1428.

Geelong, Vic.: Parabolic Dishes, alloy, 6'6" dia., with helical feed and mountings; $20 to $25. Geelong Amateur Radio-Television Club, Box 520, Geelong, 3220.

WANTED ..

Aspendale, Vic.: Helical Whips, 80, 40 and 20, for mobile work. B. Bathols, 3 Connewarra Ave.,

Melbourne, Vic.: To Buy or Borrow, for copying—Instruction Manual RCA AR77 Receiver. C. Gracie, Cavendish. Vic. 3408.

Mt. Isa, Queens.: Secondhand, good condition, Speaker 4 Drake. Price/details to G. Algie, Box 1101, Mt. Isa, Queensland, 4825.

Dapto, N.S.W.: Morse Key (pref. Post Office type); cash setlement. VK2AFF. QTHR. Ph.: Dapto 61-4287.

Townsville, Queens.: For Hy-gain TH3-Jr. Beam Ant.: Require several Complete Traps or nylon centre Insulators for traps. VK4PY, QTHR. Ph.: (077) 72-1236.

Toorak, Vic.: Has anybody a copy of June A.R. to spare If so, please let me know. VK3CIF, Box 150, Toorak, Vic., 3142.

Victoria: Johnson Match Box. W. Colborne. Ph. (03) 85-4952. A.H. (03) 419-1666, bus.

Victoria: U.K. Amateur seeks Exchange Home(s) during 1974. Further particulars from VK3ZBB. QTHR. Ph. (03) 379-4242.

Victoria: Can anybody please loan, donate or sell at reasonable price, Bradma or compatible Embossing Machine for addressing Amateur Radio 3R Plates; upper/lower case preferred. Manual or power operated. Please write or phone Business Manager.

Ballarat, Vic.: V.T.V.M., for the shack; e.g., University MVA6, Rapar MV21, &c. Write or phone Jim, 15 Victory Ave., Ballarat, 3350. Ph. (053) 34-1425.

Melbourne, Vic.: Join the Direct Conversion (Synchrodyne) Receiver Club, whose aim is to swap ideas and circuits. Send name and address, plus S.A.E., and list of circuits you have and any circuits you want, to VK3AQ, QTHR. Mail only.

SILENT KEYS

It is with deep regret that we record the passing of—

VK6FG—F. G. Clinch
VK3LZ—C. A. Ellis

KEY SECTION

With Deane Blackman,* VK3TX

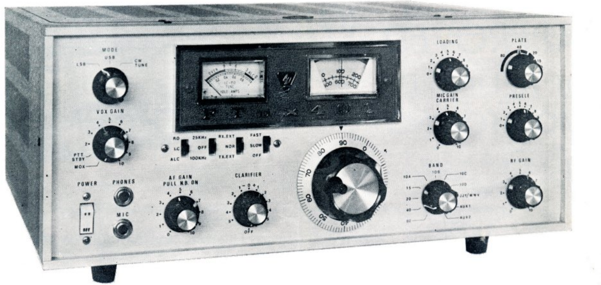
A few readers of this column were kind eonugh to write in and express their problems on finding c.w. to practice on, and I will pursue some of the suggestions made in the hope of improving the service offered. I would regard any attempt to obtain permission for holders of anything but a full licence to use c.w. on air as pretty forlorn (to mention one suggestion specifically): as I understand it the official position is rather like that of your driving licence — if you hold one you can drive (though common observation makes the truth of the rules questionable), and if you don't hold one you cannot drive. I will, however, ask.

For the more advanced student there are quite a number of commercials which put out press on c.w. They use a machine for sending and the result is as near perfect morse as you are likely to hear — though at speed. This material is copyright, but there is no problem if used only for practice and the rules regarding secrecy of radio transmissions are respected. I am collecting information on broadcasts which are suitable; if you know of any let me know and I will advertise them here.

Since October, we welcome these new members: 39, VK7RD; 40, VK3LV; 41, VK2AXK; 42, VK3BGF; 43, VK7ZD.

NFD is near, and scores in the c.w. sections count towards the President's Cup. Just about enough time to get that motor generator unseized from last year's NFD . . .

*Box 382, Clayton, Vic., 3168.



DE LUXE TRANSCEIVER *from YAESU*

YAESU

Model FT-DX-401

YAESU offers the all new YAESU FT-DX-401 SSB Transceiver. Considered the best buy in Amateur equipment available today, the FT-DX-401 features high power, super sensitivity, and sharp selectivity. In one complete station package. Except for a speaker and microphone, no other accessories are needed to be "on the air".

De luxe equipment built-in to the FT-DX-401 at no extra cost includes: AC power supply, noise blanker, dual calibrators (100 KHz. and 25 KHz.), VOX, break-in CW with sidetone, 600 Hz. sharp CW filter, clarifier, phone patch terminal, cooling fan, and WWV 10 MHz. band. Full transceive capability 80 through the complete 10 metre band. Two blank auxiliary positions are provided on the bandswitch.

The FT-DX-401 features velvet smooth tuning with zero backlash planetary gear system. Read-out to 300 Hz. is easily obtainable when calibrated to the nearest 25 KHz. marker. WWV frequency check to crystal calibrator assures "on frequency" operation on all bands.

For DX operation a noise blanker is mandatory . . . the FT-DX-401 has it! Complete with signal threshold control, the blanker picks out noise spikes completely and leaves only clean signal copy.

DUAL TOROID first I.F. stage provides high gain/bandwidth product for double conversion circuit used in the FT-DX-401. This system guarantees linear tuning rate plus high image rejection.

Twenty tubes plus fifty silicon semiconductors make up the active devices used in the Transceiver. The passive crystal filters are of the six-pole type designed for optimum SSB audio quality and sharp CW reception.

The FT-DX-401 was planned and designed specifically for the World Amateur. Export quality, with superior components and finish, specially tested. Spare parts, personalised warranty, and continuing service available through your authorised dealer.

Check the specifications and compare your cost. We believe that the FT-DX-401 is truly the best buy in the Amateur field today.

SPECIFICATIONS

Maximum Input Power: 560W. PEP SSB.
Sensitivity: 0.3 Microvolt for 10 dB. S/N (SSB 14 MHz.).
Selectivity: 2.3 KHz. (6 dB. down), 3.7 KHz. (60 dB. down) six-pole crystal filter nominal shape factor 1.6:1 for SSB; 600 Hz. (6 dB. down) 1.2 KHz. (60 dB. down) for CW.
Frequency Range: 3.5 to 4, 7 to 7.5, 10 to 10.5 WWV, 14 to 14.5, 21 to 21.5, 28 to 30 MHz.
Unwanted Sideband Suppression: 55 dB. down (at 1000 Hz.).
Carrier Suppression: 50 dB. down from full output.
Distortion Products: More than 25 dB. down.
I.F. and Image Ratio: More than 50 dB. down.
Frequency Stability: Less than 100 Hz. drift in any 30-minute period after warm-up.
Antenna Impedance: 50 to 120 ohm—SWR 2:1 or less.
Audio Output: 1.5 watts, 350-2200 Hz., 8/600 ohm impedance.
Power Source: 117 or 234 volts AC, 50/60 Hz.
Dimensions: 15¾ inch wide, 6¼ inch high, 13¾ deep.
Weight: 45 pounds.

PRICE $675.00

Optional Extras: SP-401 Speaker $28.50
FV-401 External VFO $115.00
YD-844 De Luxe Desk Microphone $39.50
Hand P.T.T. Microphone $16.50

Prices include Sales Tax. Freight extra. Prices and Specifications subject to change.

WATCH FOR ADDITIONAL MODELS SOON, INCLUDING A DIGITAL READ-OUT TRANSCEIVER!

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